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ABSTRACT

The three-year neurology manpower study reported here was directed toward (1) identifying the presently available neurological manpower and the demographic and professional characteristics of neurologists and neurologists-in-training in the United States as of 1971; (2) determining the current and emerging patterns for utilizing neurological manpower in the United States; (3) estimating the needs for neurological manpower in the United States in the coming decade; (4) evaluating the priorities to be accorded needs in the various areas of neurological activities; (5) proposing specific policy recommendations; and (6) identifying areas which require additional study and analysis. The report is organized to reflect the work of three task forces on manpower for patient care, for research, and for education. Each includes a narrative statement with conclusions and recommendations. In addition, there are twenty-three appendixes providing information and data on which the narrative statements were based. The following are representative appendix topics: funded neuroscience projects, 1971; neuropathology for the seventies; biomedical behavior research; patterns of neurologic practice; neurochemistry; the neurologist as educator; continuing education in neurology; survey on neurologic responsibilities; and the neurologist as researcher. (BB)

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NINCDS Monograph No. 16

NEUROLOGY MANPOWER—A SURVEY

A Report Prepared by the Joint Commission on Neurology of the American Neurological Association and the American Academy of Neurology

DHEW Publication No. (NIH) 77-1256

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service National Institutes of Health
National Institute of Neurological and Communicative Disorders and Stroke
Bethesda, Maryland 20014

1977

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U.S. DEPARTMENT OF HEALTH,
EDUCATION & WELFARE
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NINCDS Manpower Surveys

This volume is one of a series of five reports surveying research manpower resources and needs in disciplines of concern to the National Institute of Neurological and Communicative Disorders and Stroke, National Institutes of Health.

Prepared by various non-Government organizations under contract, the reports present data and analysis for making projections to the year 1985.

The five reports are titled as follows:

1. Neurology Manpower: A Survey
   NINCDS Monograph No. 16
2. Speech Pathology and Audiology: Manpower Resources and Needs
   NINCDS Monograph No. 17
3. Otorhinolaryngology: Manpower Resources and Needs
   NINCDS Monograph No. 18
4. Neurosurgery Manpower: A Survey
   NINCDS Monograph No. 19
5. Manpower in Basic Neurologic and Communicative Sciences: Present Status and Future Needs
   NINCDS Monograph No. 20

Copies of these reports may be obtained on request from:

Office of Scientific and Health Reports
National Institute of Neurological and
Communicative Disorders and Stroke
National Institutes of Health
Bethesda, Maryland 20014

Foreword

On August 15, 1950, President Harry S. Truman signed Public Law 81–692 which established the National Institute of Neurological Diseases and Blindness, now known as the National Institute of Neurological and Communicative Disorders and Stroke. Among its missions is the provision of training grants and awards to increase trained professional research manpower. Over a 25-year period the Institute made such opportunities available in the form of awards to individual trainees or to centers with on-going programs in neurology and its component basic sciences.

In an effort to take stock of the impact of these programs on the present status of manpower and the needs for the future, the Institute in 1972 awarded contracts to study manpower resources and needs in medical neurology, surgical neurology, otolaryngology, speech pathology and audiology, and the basic neurologic and communicative sciences. Through these contracts, the Institute planned to obtain data and make analyses upon which to base projections for personnel needs in these professional areas in 1985. The contractor chosen for the medical neurology study was the American Neurological Association (contract #72–2307).

This publication constitutes the manpower report in medical neurology. It was the responsibility of the Joint Commission on Neurology which was created as a joint group by the American Neurological Association and the American Academy of Neurology. The individuals who gave freely of their time and effort were as follows:

Executive Committee. Drs. Melvin D. Yahr, Chairman, Sidney Carter, Co-Chairman, A. B. Baker, Joe R. Brown, Paul C. Bucy, Murray Goldstein, James L. O'Leary,* Nelson G. Richards, Sidney Schulman, Hartwell Thompson, Jr., Samuel A. Trufant.

Patient Care Committee. Drs. A. B. Baker, Chairman, J. R. Brown, Vice-Chairman, Hugh D. Greer III, Simon Horenstein, Robert R. Ivers, Robert Katzman, Leonard Kurland, John Kurtzke, Donald W. Mulder, Robert R. Pierce, Charles M. Poser, Lewis P. Rowland, Jolyon S. Tucker.

Education Committee. Drs. James L. O'Leary, Chairman, Hartwell Thompson, Vice-Chairman, Alvin L. Berman, David Clark, Peter Eichman, Kenneth Magee, Richard Paddison, Fred Plum, Augustus Rose, A. L. Sahs, William Sibley, Dewey Ziegler.

Research Committee. Drs. Paul C. Bucy, Chairman, Sidney Schulman, Vice-Chairman, Robert A. Fishman, William Landau, Alfred Pope, Robert D. Terry, Charles Van Buskirk, Clinton N. Woolsey.

The National Institute of Neurological and Communicative Disorders and Stroke is grateful to these distinguished leaders in medical neurology who have given so generously of their time to accomplish the objectives of the contract. The detailed demographic information included in the report, the factual information describing the professional characteristics of neurologists, and the Commission's recommendations concerning the future manpower needs in neurology provide a basis for their own professional organizations and Federal agencies to analyze the current neurological manpower situation and its future needs in the coming decade.

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Contents

Page

Foreword ... iii

CHAPTER I. Introduction ... 1

CHAPTER II. Report of the Task Force on Manpower for Patient Care ... 7

CHAPTER III. Report of the Task Force on Manpower for Research ... 19

CHAPTER IV. Report of the Task Force on Manpower for Education ... 27

APPENDIXES

I. Neurology Manpower in the United States, 1971 ... 35

II. The National Disease and Therapeutic Index Data ... 47

III. Commission on Professional and Hospital Activities Data ... 53

IV. Source of Referral Presenting Complaint and Diagnoses in Neurological Practice ... 63

V. Observations of Neurological Practice in Different Settings ... 67

VI. Survey on Neurologic Responsibilities ... 99

VII. Task Force Definitions of Neurologic Responsibilities ... 107

VIII. Current Needs for Neurological Manpower ... 119

IX. Innovations to Extend the Neurologist's Reach ... 135

X. Patterns of Neurologic Practice ... 139

XI. The Neurologist as Researcher ... 143

XII. Funded Neuroscience Projects, 1971 ... 149

XIII. Present Status and Future of Basic Research in Neuroscience ... 155

XIV. Neuropathology for the Seventies ... 159

XV. Neurochemistry ... 161

XVI. Biomedical Behavior Research ... 165

XVII. Neurological Research as Viewed by the Practicing Neurologist ... 177

XVIII. Research Task Force ... 179

XIX. The Neurologist as Educator ... 181

XX. Undergraduate Medical Education in Neurological Sciences ... 185

XXI. Specialty Training in Neurology ... 191

XXII. Continuing Education in Neurology ... 195

XXIII. The Training of the Academic Neurologist ... 199

Chapter I.

Introduction

General Goals

In response to the many criticisms made of our health care system over the past decade, suggestions for its modification have not only been proposed but in some areas implemented. Although it is too early to predict the precise nature of our future health care system, it will undoubtedly differ from that which prevails. Given that changes will occur, those responsible for medical care in our Nation must take an active role in determining the nature of these changes and in insuring that the health needs of our people are met. Since American medicine is in large part organized along specialty lines, it is incumbent upon each specialty to evaluate its current effectiveness and future role. The neurological community, through its representative national organizations—the American Neurological Association and the American Academy of Neurology—in cooperation with the National Institutes of Health has undertaken such an effort. The report which follows is a result of three years of study directed toward:

1. Identifying the presently available neurological manpower and the demographic and professional characteristics of neurologists and neurologists-in-training in the United States as of 1971.
2. Determining the current and emerging patterns for utilizing neurological manpower in the United States.
3. Estimating the "needs" for neurological manpower in the United States in the coming decade.
4. Evaluating the priorities to be accorded "needs" in the various areas of neurological activities.
5. Proposing, where feasible, specific policy recommendations with respect to national health goals in neurology and the means for achieving those goals.
6. Identifying those areas which require additional study and analysis in order to enhance our capability for determining resources and needs in the future.

Background

The emergence of neurology as a distinct medical discipline in the United States began during the Civil War when the United States Army first designated a center for the care of diseases of the nervous system. This center attracted those physicians who wished to explore and study the many and varied disorders of the brain, spinal cord and peripheral nerves. In line with the traditions of the European schools in which many of these physicians had been trained, a close alliance between neurology and psychiatry was established as the model for training and practice in these fields. Aside from a small number of physicians whose activities were restricted to clinics and university medical centers, neurology as a separate specialty was the exception rather than the rule until the conclusion of World War II. Increasing interest in neurology as a separate discipline developed during the war. The highly departmentalized structure of the armed services medical corps permitted numerous physicians to become identified with particular specialties for the first time. One of the larger departments of the armed forces was neuropsychiatry and many physicians who received their first exposure to the complex and fascinating disturbances of the nervous system, both emotional and organic, in the army, sought more intensive training after the war. It soon became apparent that the interests and needs of those training for careers in neurology were divergent from those headed for psychiatry. The growth of information in neurobiology (in chemistry and physiology) on the one hand and psychology on the other was occurring at such a rapid rate that few could expect to bridge both fields. Separation of the two began to be accepted in many parts of the country. While the training programs available at that time were still designed to prepare individuals for the combined practice of neurology and psychiatry, exceptions did exist in the academic community. A separation of these disciplines had evolved in response to teaching commitments and individual research interests of particular department heads.

The establishment of the National Institute of Neurological Diseases and Stroke (originally titled the National Institute of Neurological Diseases and Blindness) perhaps more than any other single event served as a catalyst to foster the development of neurology as a distinct and separate specialty in this country. Indeed, Severinghaus has credited the NINDS with responsibility "for the birth of neurology as an independent specialty."[1] Certainly, the phenomenal expansion of neurology as a specialty paralleled the availability of federal funds for training and research. With respect to funding, NINDS appropriations for grants and direct operations grew from $4,500,000 in 1954 to $116,500,000 in 1972, research grant appropriations grew from $2,700,000 in fiscal 1954 to $68,435,000 in fiscal 1972 and training program and fellowship award appropriations increased in that same period from $760,000 to $18,110,000. (It should be noted that these 1972 figures do not represent the high point of funding—the highest levels were respectively $128,934,000 in fiscal 1967, $84,400,000 in fiscal 1968 and $23,150,000 in fiscal 1969.)

With respect to the changes in the field of neurology during this period, there were, in 1950, 67 approved residency training programs in neurology offering 214 positions; by 1973–74 more than 100 residency training programs offered almost 1,100 residency positions. In 1949, of the 63,000 physicians who limited themselves to practice of a specialty, 2,400 practiced a combination of psychiatry and neurology and only 100 limited their practice to neurology. (Additionally, about 250 physicians were "part-time specialists" in neurology alone.)[2] As of December 1971, almost 3,400 physicians regarded themselves as primary specialists in neurology. In 1949, less than 0.2 percent of all specialists devoted themselves solely to neurology while in 1971 about 1.3 percent of all specialists were neurologists, a very substantial increase both absolutely and relative to the total number of specialists.

These developments of the past two decades, the large scale allocation of federal funds to support training and research in neurology and the growth of neurology as a specialty, were neither arbitrary nor chance occurrences. Rather, they flowed from explicit decisions by the government as to appropriate priorities in health in the light of neurological disorders in the population and public demand for improved diagnosis and treatment of these disorders.

However, no set of priorities, however wisely chosen, is necessarily enduring. Thus, in response to criticisms of the health care system, priorities are moving away from an emphasis on biomedical research to an emphasis on the provision of health care. Efforts are being exerted to determine how the health care delivery system can be made more efficient and humane and better able to provide adequate care to all those in need; how health care manpower can best be utilized; and how to best prepare future physicians in light of our changing priorities. Neurology is part of that system and is being asked parallel questions: What are the present needs of the country for neurological care? Are there enough neurologists available, and if not, do we have the capability of producing sufficient numbers? What neurological disease areas should have the highest claim upon us and in which areas does research give us the most promise of improved diagnosis and treatment?

Any attempt to answer these questions must take into account the incidence and prevalence of neurological diseases; the disabilities they create; our ability to treat and prevent them; and the potential for progress in understanding them. It will undoubtedly be a long time before any final answers to these and other significant questions emerge. The Joint Commission represents an initial attempt to establish a basis for providing coherent and viable answers to these questions in the field of neurology.

The importance of this attempt by the Commission to assess the appropriate future of neurology as a medical specialty and its role in American medicine and the American health care system derives from the fact that the future of neurology is inseparable from any attempt to better deal with the consequences of neurologic disease for patients, their families and the wider society. Neurologists comprised only 1.3 percent of all physicians and an even smaller proportion of those physicians whose primary activity was patient care in 1971. But those patients whose primary medical problem was neurologic in nature utilized 4.1 percent of the visits to private physicians in the National Disease and Therapeutic Index panel of physicians in 1965, 4.3 percent of the visits in 1967 and 4.5 percent in 1971. In addition, neurologic disorders comprised 8.1 percent of the more than ten million primary diagnoses recorded by the hospitals participating in the work of the Commission on Professional and Hospital Activities for the year 1971. (This does not include all those patients whose secondary diagnoses were of neurologic diseases.)

Even if all patients with neurologic disease need not be under the care of neurologists, still these data certainly suggest that there may be a major disjunction between the number of patients suffering from neurologic disease and the neurologic manpower available to provide care. And many neurologic diseases, e.g., amyotrophic lateral sclerosis, where the patient undergoes a progressive, ultimately complete paralysis while still fully conscious, are among the most terrible afflictions of man.

The economic cost to society of neurologic disease should also be noted. Dorothy P. Rice, in her classic study, "Estimating the Cost of Illness," defines the cost of illness as the sum of direct expenditures for care plus the indirect costs of morbidity and mortality and concludes that 7 percent of the annual cost of all diagnoses is assignable to diseases of the nervous system and sense organs.[3]

It is also possible to approximate the costs of specific neurologic diseases such as epilepsy, stroke and multiple sclerosis. Per capita estimates of the costs for direct care to patients with these disorders have been generated by NINDS.[4] If the per capita costs of these illnesses are multiplied by the prevalence figures prepared for the Commission, the direct costs for patient care total over three billion dollars per year. The "loss to the economy," i.e., the loss to the gross national product and in federal taxes, because of these three disorders totals almost 29 billion dollars per year. See below:

	No. of Patients	Patient Care (per annum)	Loss to G.N.P. (per annum)	Loss to Federal Taxes (per annum)
Epilepsy	1,000,000	$1,000,000,000	$12,376,500,000	$43,500,000
Multiple Sclerosis	100,000	200,000,000	4,125,000,000	14,400,000
Stroke	1,000,000	2,000,000,000	12,376,500,000	43,500,000
Total:		$3,200,000,000	$28,878,000,000	$101,400,000

These considerations, of patient need, personal and familial suffering and social costs, comprise the broader context of the Joint Commission's concern with manpower resources and needs in neurology.

The Structure of the Report

Structurally, the Joint Commission on Neurology included an Executive Committee, three Task Forces—one on patient care, one on research and one on education—and a central staff. Each Task Force, under the overall supervision of the Executive Committee and with the assistance of Commission staff, prepared a series of reports dealing with resources and needs in their area of concern. Ultimate responsibility for coordinating and preparing the final report was assigned to the Commission staff under the supervision of the Executive Committee.

The organization of this report parallels the Task Force structure of the Commission. Thus, the findings and conclusions with respect to patient care, research and education are dealt with separately. The actual sequence—patient care, research and education—reflects two basic assumptions: first, that the major determinant of policies in biomedicine, whether with respect to patient care, research or education, should be patient needs; and second, that educational goals should in large part derive from the goals established with respect to patient care and research.

Each section of the report includes two major components—a narrative statement and the appendices upon which the narrative statement is largely based. The conclusions and recommendations given in the statement rest upon and derive from the data and conceptualizations in the appendices. Much of the data presented in the appendices not only touches upon important issues in patient care, research and education but is also unavailable elsewhere. Thus, a number of the appendices are of significance in their own right.

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Chapter II.

Report of the Task Force on Manpower for Patient Care

Manpower for Patient Care

INTRODUCTION

This report on manpower resources and needs for patient care in neurology will deal with three major areas:

1) The neurologic manpower resources currently available for meeting existing demands for patient care.
2) The projected need for neurological manpower to meet the demands for patient care in 1985.
3) Factors influencing the utilization of neurological resources.

Currently Available Resources

This review of currently available resources is based upon five separate studies:

1) Appendix I: "Neurology Manpower in the United States, 1971," primarily an analysis of the data file on neurologists maintained by the American Medical Association's Center for Health Services Research and Development but also including supplementary data.
2) Appendix II: "The National Disease and Therapeutic Index Data," an analysis of data on ambulatory care among private practitioners.
3) Appendix III: "The Commission on Professional and Hospital Activities Data," an analysis of data on hospitalized patients.
4) Appendix IV: "Source of Referral, Presenting Complaint and Diagnoses in Neurological Practice," an analysis of the data obtained in a study carried out by the Joint Commission.
5) Appendix V: "Observations of Neurological Practice in Different Settings," qualitative reports on six different neurologists in six different practice settings.

Rather obviously, the Joint Commission has defined its responsibility for determining currently available resources broadly. The goal is not only to specify the number of neurologists involved in patient care but to provide a context, that of the realities of neurological practice for interpreting these figures.

As of 1971, there were 3,398 M.D.'s plus seven Doctors of Osteopathy who described themselves to the A.M.A. as neurologists. This group, of whom 1,194 could be identified as board certified, comprised slightly less than 1 percent of all physicians in the United States as of December 31, 1971. (This is somewhat more than the 2,749 neurologists listed in the 1971 membership directory of the American Academy of Neurology.)

Neurologists tend to be appreciably younger (median age, 39) than all other physicians (median age, 44). This undoubtedly reflects the trend in recent years for proportionately more young physicians to choose neurology as their specialty. Indeed 23 percent of all neurologists are still in training. (This fact plus the relative youth of all neurologists may help explain why only 35 percent are board certified.)

The strong interest in neurology as a specialty is a relatively recent phenomenon, roughly dating from 1950, and has been facilitated by the availability of funding for neurology training programs. There are indications that as this funding has decreased, recruitment of physicians into the field has also decreased.

Women comprise a slightly higher proportion of neurologists (7.3 percent) than they do of all physicians (6.3 percent), a difference which may become greater in the future; choice of neurology as a specialty is a more recent phenomenon among women than among men. Given the increasing number of women entering medical school, attempts to ascertain the factors associated with sex preferences in specialty choice may contribute to more effective recruitment by neurology. (It should also be noted that women in neurology are somewhat more likely than men to describe their primary professional activity as direct patient care.)

Of the 3,398 neurologists on the A.M.A. file, 724 are graduates of foreign medical schools, 2,577 are American medical school graduates and 97 are graduates of Canadian medical schools. (Compared to other specialties, neurology does not appear to have a distinctive appeal to foreign graduates: Indeed the proportion of such graduates in neurology is almost at the median for all specialties.) Of the American medical graduates, approximately 60 percent are graduates of privately owned medical schools, 40 percent of publicly owned ones. (The latter are somewhat more likely to describe their primary professional activity as patient care and to approximate in their present location the distribution of the population in the United States.)

An examination of the specific medical schools from which neurologists graduate suggests that certain schools tend to "produce" a disproportionate share of neurologists. If we accept the notion, on the basis of these data, that the medical school experience can strongly influence specialty choice, then an examination of the relation between "neurology" experience in schools and choice of neurology among graduates might provide useful insights for educators in neurology.

Because of the Joint Commission's concern with the availability of neurological care, the present location of neurologists was studied in some detail. While there is at least one neurologist in every state except South Dakota (as of December 31, 1971), the distribution of neurologists among the States is markedly uneven: 49 percent of all neurologists are located in six states in which there are about 40 percent of all M.D.'s, but only about 31 percent of the population. If we look at the ratio within states (excluding South Dakota) of active, trained nonfederal neurologists to population, the range is from 0.2 neurologists per 100,000 population (Nevada and Arkansas) to 4.4 per 100,000 (District of Columbia). A similar maldistribution exists with respect to census regions, ranging from 2.5 neurologists per 100,000 population in New England to 0.8 per 100,000 in the east south central area. An examination of the relation between location of neurologists and population density as measured by SMSA's (standard metropolitan statistical areas) suggests a major determinant of this maldistribution is the fact that neurology is a big-city specialty. And there is no suggestion in the data that this tendency to cluster in large metropolitan areas is about to change, it being true of neurologists of all ages.

It would appear, therefore, that one of the major concerns of American neurology over the next decade must not only be to ensure a sufficient number of neurologists to provide care but also to ensure a more equitable distribution of or at least access to the neurologists who provide care.

Physicians are called upon to carry out a number of different tasks. The American Medical Association divides professional activities into five main categories: Direct Patient Care, Medical Teaching, Medical Research, Administration, and Others. How do neurologists allocate their time among these activities: Approximately three-fourths of all neurologists, this including residents in training, describe their primary professional activity as direct patient care. (This is less than is the case with all M.D.'s, over four-fifths of whom describe their primary professional activity as direct patient care.)

It should also be noted that neurologists are more likely to indicate medical teaching as their primary activity than are all physicians. This possibly reflects the recent expansion of the field and the need to develop an educational substructure to permit that expansion. Additionally, neurology is a research oriented specialty, indeed second only to gastroenterology in the percentage of its practitioners engaged primarily in research. Of course, with the increasing pressure on physicians to provide more direct patient care in the future and with the decline in federal funds for research, it seems reasonable to expect that the relative emphasis placed on research by neurology and some other specialties will be diminishing for an indeterminate period. There has been a greater percentage increase choice of patient care activities by neurologists since 1968 than is true of other M.D.'s, but this appears to be a function of the proportionately greater increase in neurological residents.

Given the proportion of neurologists who are in training, research and medical teaching, the fact that neurologists are less likely to describe office-based solo practice as their professional setting is not surprising. However, the relative youth of neurologists is probably an additional factor, since solo practice is more usual among physicians 55 years of age and over.

These data from the A.M.A. file reflect self-definitions of primary professional activities. In order to obtain some idea of the actual amount of time devoted to different professional activities, particularly patient care, the American Academy of Neurology conducted a special survey of its membership in 1973.

The results of this survey indicate that the median number of hours worked per week by neurologists is 61.6, a figure which is not out of line with the hours reported by other physicians. Roughly, 92 percent of the sample report spending more than 10 percent of their time in patient care. Indeed the largest single allocation of professional time, roughly 54 percent of the total, is to patient care. This averages approximately 33 hours a week for each neurologist in this sample. The median number of individual patients (as opposed to patient visits) seen by a neurologist during the course of a year is 863. And, for what such a global estimate signifies, roughly 1.85 hours (111 minutes) is devoted to each patient on the average in the course of the year.

In one sense, these figures give a picture of the neurological resources available for patient care, but in another sense they do not. Resources as such are an abstraction and have meaning only in terms of the demands upon them and the ways in which they are utilized. In short, neurological resources need to be looked at from the perspective of neurological practice.

In order to get some idea of what neurological practice involves, particularly in terms of patient caseload, a series of studies and data analyses were carried out by the Joint Commission. Because of the concern with "practice" the focus was upon the "actual" neurological caseload, those tied into the health care system, rather than upon the true "neurological" caseload; nonetheless, a great deal of data on neurological symptoms and diseases per se were obtained and these are presented in the appendixes of this report.

In 1971, patients with a neurological diagnosis comprised 4.5 percent of all ambulatory patients served by the physicians in the N.D.T.I. panel. Patients with a primary neurological diagnosis comprised 8.1 percent of all hospitalized patients in the C.P.H.A. file, while those with a primary and/or secondary neurological diagnosis comprised 13.1 percent of the total.

Given that neurologists comprise less than one percent of all physicians, and an even smaller proportion of those primarily involved in patient care, it seems reasonable to expect that a large part of the neurological caseload is cared for by other specialties. This is certainly true among ambulatory patients, neurologists caring for only one percent of all patients with neurological diseases in the N.D.T.I. sample in 1971. The major bulk of neurological care is, as one would expect, provided by internists and general practitioners. (Five percent of all such patients are seen by neurosurgeons.)

The relatively small role of neurologists in the ambulatory care of private patients should be a matter of concern. While many, possibly the great majority of the neurological patients seen by physicians other than neurologists are undoubtedly receiving adequate care, a better understanding of the determinants of the limited role of the neurologist in ambulatory private practice is called for: To what extent is this limited role due to the limited availability of neurologists, particularly in private practice, to what extent is it due to other factors, for example, a reluctance to refer, for whatever reason, patients to a neurologist? It is not only the status of neurology which is involved in this decision but, quite likely, the quality of care received by patients. (The N.D.T.I. data indicate that neurologists are more likely than other physicians to come up with specific diagnoses.)

It is very likely that the referral process is linked to the definitions which physicians have to neurological disease. There appear to be a number of diseases which are defined as "neurological" ones; i.e., where the neurologist is proportionately more likely to be treating the patient. These include convulsive disorders, multiple sclerosis, parkinsonism, tumors of the central nervous system, trigeminal neuralgia, motor-neuron disease and encephalitis. Conversely, there are a number of "neurological" disorders, e.g., cerebrovascular disease, which are proportionately less likely to be seen by a neurologist.

This issue, of the factors involved in physician referrals to neurologists, is important because of the nature of neurological practice. In the referral study carried out by the Joint Commission, only 5.9 percent of all referrals to neurologists were self-referrals; approximately nine out of ten of the referrals were from other physicians or from a health facility. It should be noted that those referrals which were made indicate a good definition of the neurologist's competence, only 3.4 percent of all referrals being diagnosed as having something other than a neurological disease. It is the other side of the coin, those patients with a neurological diagnosis who are not referred, which appears to be the problem.

In light of the major role occupied by physicians other than neurologists in the care of ambulatory private patients with neurological diagnoses, efforts to optimize the "neurological" competence of these physicians needs to be undertaken. In addition, neurology should attempt to develop an explicit and cogent rationale which could serve as a guide to help physicians decide when referrals to a neurologist are called for. Also, because of the importance of this issue, an empirical analysis of the factors involved in the actual referral process is needed.

Because the concern here is with those aspects of neurological practice which may directly affect the utilization of manpower resources, the body of findings reported in the various appendixes which deal with referrals, presenting complaints, and the correlates of neurological disease and treatment will not be discussed here. However, it should be noted that among patients actually in contact with the health care system, roughly two-thirds of all presenting complaints and of all final diagnoses are accounted for by a limited number of entities. Insofar as medical education should reflect the caseload realities in practice, these data suggest some potential areas of emphases in both the undergraduate and graduate training of non-neurologists.

In addition, there are some findings of interest in and of themselves which might be noted. First, ambulatory private patients with neurological diagnoses seen by neurologists appear to be appreciably younger than those who go to other physicians. And second, it appears that the use of diagnostic techniques varies with the region of the country; e.g., the Northeast is more likely to report the use of echoencephelography while the West tends to emphasize myelography.

Finally, there is at present a great deal of interest in the effects of practice setting upon medical practice. A large scale empirical study in this area could not be undertaken by the Joint Commission given the limited time and resources available. However, some exploratory qualitative work, involving the observations of six different neurologists in six different practice settings, was carried out. The practice settings were from different sections of the country, in both urban and rural areas and included solo practice, group private practice, fee-for-service multi-specialty group practice, pre-paid multi-specialty practice, hospital-based salary practice and military hospital-based practice. Similarities and differences, particularly in terms of the amount of time devoted to professional activities and to patient care, were noted, and narrative descriptions of each of the neurologists observed were prepared. These observations can both convey a better understanding of neurologic practice to laymen and serve as a useful resource in medical education. Both the narrative reports and a brief analysis of them are included in Appendix V. Nonetheless, more detailed studies of the impact of setting upon practice are required.

Projected Need, 1985

The Joint Commission was not only charged with examining the current neurological resources available for patient care but also with estimating the "need" for neurology manpower in 1985. This entails three separate estimates:

1) The number of neurologists required to meet the demands of patient care in 1985;
2) the number of neurologists likely to be available to meet those demands in 1985; and
3) the probable discrepancy, if any, between "needs" and resources in 1985.

Any estimate of manpower "need" is not solely or even primarily an empirical issue. Rather, it depends to a large extent upon the value judgments and assumptions which are incorporated into the equations used. Nor is there any way to avoid dealing with value judgments and assumptions for they are implicit in the concept itself.

The concept of "need" implies a value commitment, the wish to realize a specific goal. Logically there is no such thing as a "need" per se, only a "need" for "a" if we wish to achieve "b". Thus, food is only a necessity as long as the individual wishes to survive. Once survival is no longer a goal, food is no longer a necessity. Hence, any attempt to estimate the need for neurological manpower to meet the demands of patient care must take into account, implicitly or explicitly, the goals we want to realize with respect to patient care; i.e., the level of care we wish to provide to patients with neurologic disease. More specifically, this means that the number of neurologists "needed" for patient care depends in large part upon our answers to the following questions:

1) What is the level of responsibility which neurologists should assume for the screening and diagnosis of patients with the various symptoms suggestive of neurological disease?
2) What is the level of responsibility which neurologists should assume for the care and treatment of patients with the different neurologic disorders?
3) If there is a difference between the "true" neurologic caseload (incidence and prevalence of the various symptoms and diseases) and the "actual" neurologic caseload (those patients coming into contact with the health care system), which is our goal—to have sufficient neurologists to treat "actual" or the "true" caseload?
4) What should be the frequency and length of neurologist-patient contacts?
5) How much of their professional time should neurologists devote to patient care?

Thus far, we have indicated some of the major questions inherent in a definition of the concept "need" for neurologists. However, the charge to the Joint Commission includes the responsibility of projecting estimates of need to 1985. Any projection to the future must rest upon assumptions about that future. For example, what will the neurologic caseload be in 1985? Specifically, how it will be affected by changes in the size of the population and its age and sex distribution, all of which relate to the incidence and prevalence of neurologic disorders?

Also of importance to any projection to 1985 is the degree to which there will be changes in the nature of patient care demands upon neurologists. For example, therapeutic innovations can affect the "need" for neurologic care: penicillin has led to the virtual disappearance of general paresis as a clinical entity, but L-Dopa has led to increased demands upon neurologists in the care of parkinsonism. Can we specify the therapeutic advances which will have emerged by 1985 and the effects of these developments upon neurologic care?

Finally, if estimates are to be made of the need for patient care neurologists in 1985, assumptions about the patient care capacity of neurologists in the future need to be made. Neurologists have tended to choose research and teaching careers more than other specialists, but this pattern may be changing. And on the other hand, it remains to be seen whether physicians will continue to devote 55–70 hours per week to their professional activities.

Given that estimates of neurologic manpower needs for the future must rest upon both value judgments and problematic assumptions, a major goal of the Joint Commission was the development of a methodology for estimating manpower needs which would meet two criteria. First, all value judgments and assumptions incorporated into the equations, including the rationale for the choices made, should be explicitly stated. Second, the validity of the methodology should be separable from the validity of specific estimates. More specifically, the equation to be used in deriving estimates should permit easy incorporation of alternative weights reflecting different value judgments and assumptions. Thus, the choices available to us would not only be acceptance or rejection of the estimate given, but would also include the possibility of developing a new, more acceptable estimate based upon corrections of the specific weights attached to the various elements in the equation.

Given these considerations, three major steps were taken. The first of these was the decision that estimates of future needs for neurologic manpower to meet the demands of patient care should be based upon an estimate of current needs (1971) extrapolated to 1985. Steps two and three were concerned with explicating the value judgments inherent in a definition of need and the assumptions implicit in a projection to 1985.

To a large extent, the following analysis of our current need for neurological manpower is based upon three appendices:

1) Appendix VI: "Survey on Neurologic Responsibilities." Report of a mail survey on a sample of neurologists carried out by the Joint Commission.
2) Appendix VII: "Task Force Definitions of Neurologic Responsibilities."
3) Appendix VIII: "Current Needs for Neurological Manpower."

The first step taken to define the current need for neurological manpower entailed a determination of the level of responsibility which neurologists should assume for the screening and diagnosis of symptoms suggestive of neurological disorders and for the care of patients with neurological disorders. Even though such a determination is, at this point in time, a matter of judgment, empirical data on the beliefs of individuals conversant with neurological problems can be useful. Thus, two mail surveys of neurologists were undertaken: the first asked a sample of 500 neurologists to specify, on the basis of their clinical experience, the percentage of patients with various symptoms that should be seen by a neurologist; the second asked a different sample of 500 neurologists to allocate the degree of responsibility which neurologists should assume for the care of patients with various disorders. The particular symptoms and disease entities covered in the two questionnaires were chosen by experienced clinical neurologists and a neuroepidemiologist using two criteria: that they involve the central and peripheral nervous systems and that they be among the more common neurological problems in the population and/or in clinical practice. (The results of these two surveys are given in Appendix VI.)

Of course, neurologists are not the only professionals who care for patients with neurological symptoms and disorders; general practitioners, internists, neurosurgeons, nurses, rehabilitation workers, etc., all provide care to significant numbers of neurological patients, and their views may differ from those of neurologists. Ideally, each of these groups should have been surveyed to obtain a more comprehensive picture of expert beliefs but this was an effort beyond the resources of the Joint Commission. Given the importance of such judgments in any determination of manpower needs, comprehensive surveys of this nature among various specialties and professions should be undertaken and used as a basis for developing a broader professional consensus as to the allocation of responsibilities for the care of neurological and other health disorders.

Once the results of the two surveys were tabulated, the Task Force on Patient Services of the Joint Commission reviewed them and prepared its own consensus as to the appropriate level of neurology's responsibility for the screening and care of neurological patients. By and large, the Task Force proposed a greater degree of responsibility for neurologists than did the samples surveyed (Appendix VII). One reason for these differences was the adoption by the Task Force of "ideal" patient care as the standard of judgment. Using this standard, and assuming that neurologists are more expert in both the screening and care of neurological disorders than are other specialists or professionals, the Task Force developed specific estimates as of the level of neurologic responsibility required for various symptoms and disorders. In addition, the Task Force prepared a statement of justification of its decisions on each symptom and disease entity. (See Appendix VII.)

The second step taken in defining "need" was the decision to use the "true" as opposed to "actual" neurological caseload as the basis for determining the number of neurologists required in patient care. (Incidence and prevalence figures for each of the symptoms and disease entities included in Appendix VII were prepared under the supervision of Dr. John Kurtzke and are given in Appendix VIII.)

The next step was the determination, on the basis of a consensual judgment by the Task Force, of both the frequency and length of neurologist-patient contacts appropriate for each problem. Again the standard applied was that of "ideal" care. Thus, both the frequency and length of visits prescribed by the Task Force appear to be appreciably higher than those which actually prevail (at least as indicated by the data in Appendices I and V). This use of "ideal" care as the standard unfortunately precluded any consideration of the emerging issue of priorities in patient care, the allocation of scarce neurological resources on the basis of explicit criteria, e.g., the greatest potential for a therapeutic impact. Thus, the Task Force determined that each new case of dementia required three hours of a neurologist's time and that approximately one-fourth of existing dementia cases required two hours of neurological care during the year even though the therapeutic possibilities with respect to dementia are extremely limited.

The final step, the calculation of current need in terms of neurological man hours required per year to deal with the specific symptoms and disease entities reviewed, yielded an estimate of 12,746,000 hours/year. Since the specific diagnoses included in this estimate represented only 73.8 percent of all neurological patients in the study of "Presenting Complaints, Final Diagnoses and Source of Referral" (Appendix IV), a corrected estimate to account for all neurological problems yielded a total of 17,300,000 hours required per year. (The steps in the calculation are described in Appendix VIII, Tables XXIII and XXIV.)

If it is assumed, on the basis of the American Academy of Neurology Survey, that neurologists devote 33 hours a week (and 50 weeks per year) to patient care, then 10,500 neurologists are currently needed to meet the standards of care established by the Task Force, 7,100 more than are now (1971) available. Of course, any change in the weights used—reducing the level of diagnostic and treatment responsibility prescribed for neurologists, emphasizing the "actual" rather than the "true" caseload, establishing priorities of care for different patients, reducing the recommended frequency and length of patient contacts, increasing the number of hours devoted to patient care, etc.—the smaller the number of neurologists required and the smaller the shortfall.

In order to develop an approximation of the number of neurologists needed for patient care in 1985, the U.S. Census Bureau estimates of population change were used. There are four estimates, each reflecting different assumptions about fertility. Series F assumes the lowest level of fertility, 1.8 births per woman, and projects a population of 230,913,000 by 1985. Series C assumes the highest level of fertility, 2.8 births per woman, and projects a population of 248,711,000 by 1985. On the basis of these estimates, the increase in the population should be somewhere between 15 percent and 24 percent.

If we assume that all other factors will remain equal, that both the proportion of the population afflicted with neurological problems and the distribution of these problems will be the same in 1985 as was estimated for 1971 (Appendix VIII), that there will be no major preventative or therapeutic innovations, and that there will be no significant developments in the use of alternative health care personnel in the care of neurological patients, then, using the standards of care established by the Task Force, the number of neurologists needed for patient care in 1985 can range from 12,000 (smallest population growth) to 13,000 (largest population growth).

This type of extrapolation, one assuming no major changes, was chosen for a number of reasons. It is, of course, the simplest from a technical viewpoint. Further, attempts to predict social changes, to attach quantitative weights to them and to incorporate these weights into the equations are not only complicated but, our prophetic capacities being what they are, are as likely to contribute to error as to accuracy. And it does not appear that any such attempt, if kept within the bounds of what may be realistically anticipated, will influence the final estimate greatly. By and large, if these projections are to be modified, it must be through modifications of the specific weights given the various elements in the equation for estimating current need. It is this equation which determines the parameters for any projections, and, even more, both empirical data and informed judgment can more easily be brought to bear on the specifics of the equation than on the outlines of the future.

Nonetheless, one possible development should be noted. National policy in health care increasingly emphasizes priorities in patient care as opposed to education and research. The relative emphasis upon research and educational activities in neurology probably reflects, as noted earlier, the no longer exigent need to build an infra-structure for the field. It is very likely, therefore, that neurologists will proportionately devote more of their professional time to patient care. If this assumption is valid and if we assume that by 1985 neurologists will, on the average be devoting 40 hours a week, fifty weeks a year to patient care, then the need may range from 9,950 to 10,700 neurologists.

The emphasis thus far has been upon estimating the anticipated need for patient-care neurologists in 1985. However, if these estimates are to be used as a basis for planning, we need to have some idea of the number of neurologists likely to be available at that time. Three estimates were calculated, each reflecting a different set of assumptions.

First, if we assume that the rate of increase in the number of neurologists which took place from 1963 to 1971 will continue, a straight-line projection with no allowance for attrition yields an estimate of about 10,000 neurologists available in 1985. If the 643 neurologists on the A.M.A. file who will be 64 years of age or older in 1985 are subtracted, there will be approximately *9,450* neurologists in 1985, an increase of some 180 percent over 1971.

A second, smaller estimate was drawn up on the basis of the following three assumptions:

1) The number of filled residency positions will increase each year by 1.6 percent to a total of 1,065 in 1985 (125 percent of the 1971 total of 854 given in JAMA);
2) The annual increment to the total number of neurologists will equal one-third of the filled residencies; and
3) The allowance for attrition through retirement or death can be made by subtracting the 643 neurologists who will be 64 years of age or older in 1985 from the total.

On this basis, the total number of neurologists in 1985 would be 7,265, an increase of 114 percent over the 3,398 available in 1971.

The third and final estimate is also based upon three assumptions:

1) The number of filled residencies will remain constant at the 1971 number (854);
2) The annual addition to the total number of neurologists will be 854/3 or 284; and
3) The attrition due to retirement or death will total 643, those neurologists in the A.M.A. file who will be 64 years of age or older in 1985.

On this basis the total number of neurologists in 1985 would be 6,740, an increase of 98 percent over the 3,398 listed on the A.M.A. file in 1971.

Which of these three estimates will most closely approximate reality cannot be determined. But they can be used to give some indication of the possible shortfall of patient care neurologists as of 1985. The maximum estimate of need for 1985 is 13,000 neurologists, the minimum 9,950. The maximum estimate of the number of neurologists likely to be available is 9,450, the minimum, 6,740. On the basis of these estimates, it would appear that the shortfall of patient care neurologists in 1985 can range from approximately 500 to more than 6,000 neurologists.

This range is indeed large but, given the ambiguities inherent in the determination of need and in projections to the future, should not be considered too surprising. However, surprising or not, the imprecision in our estimates is undesirable. And while the methodology for projecting future estimates is the responsibility of manpower research professionals, the methodology of defining and determining "need" is a task which is a responsibility of the health care field and neurology.

The Utilization of Neurological Manpower

The various estimates of the current and future need for neurological manpower were based upon a number of assumptions. Thus, it was assumed that prevailing patterns in the organization and delivery of health and neurological care would remain unchanged, primarily because the changes which will take place and their impact upon manpower utilization are unknowns at this point to permit any rational quantification. Despite our inability to take such factors into account in estimating the need for neurologic manpower in 1985, changes in the organization and utilization of medical manpower appear not only inevitable but also desirable. From an economic point of view, neurologists are scarce, high cost resources. Because of this, a major concern in health care delivery must be the development of viable innovations which can lead to a more efficient and intensive use of the neurologist, and to the use of less scarce and less costly resources in the provision of neurologic care to the extent which this is possible without a diminution in the quality of care provided.

Many changes in this area are possible, ranging from a federalization of the health care system, paralleling the English model, to very discrete and limited innovations at the interface between physician and patient. Some of the potentially most significant possibilities are beyond our capacity to describe or evaluate. This includes all proposals involving federalization of the system. (Of course, insofar as proposals for an enhanced governmental role in reimbursements for services are concerned, an increased demand for health care services including neurologic care can be assumed.) The emerging patterns of practice and the effects of different types of practice settings upon manpower utilization comprise a second area of possible change beyond our capacity to evaluate. However, because of its importance, this is an area requiring additional research.

The focus here will be upon more limited types of innovations which can affect the need for neurological manpower, in particular those which can serve to extend the "reach" of the neurologist and so make for more effective use of available neurologic resources. (The concept of "reach" includes two major components: enhancement of the neurologist's capacity to provide care, directly or indirectly to more patients; and enhancement of the neurologist's capacity to care for patients at a distance, obviating the need to bring the patient into direct contact with the neurologist, thus offsetting, at least to some extent, the uneven distribution and access of neurologists.) These innovations include the application of technology to health care delivery, alternative uses of personnel, and structural changes on a limited level which might serve to enhance the quality of neurologic care given to patients. The discussion which follows is based upon material in the following appendices:

1) Appendix IX: "Innovations to Extend the Neurologist's 'Reach'."
2) Appendix X: "Patterns of Neurologic Practice."

A review of some of the ongoing experimental programs involving the application of technology to health care delivery and the use of alternative personnel indicates that four general approaches are being followed. (Only a small and not necessarily representative sample of such innovations were reviewed.) These four approaches include:

1) The use of radio, telephone and television in educational programs for physicians and other health care professionals;
2) the use of these technologies plus computers in the provision of direct patient care;
3) the use of alternative personnel in direct patient care: and
4) the use of combinations of technology and alternative personnel in the provision of direct patient care.

Examples of radio, telephone and television include the Albany Regional Program which has provided continuing education to physicians by means of two-way radio conferences since 1955; the dial-access libraries by which many university medical centers make short tapes on a wide variety of subjects available; and the three-way conferences on mental retardation combining telephonic tie-ins and videotapes developed at the University of Nebraska Medical School.

Attempts to apply technology to direct patient care include the University of Alabama's medical information service via telephone (MIST) which is available to physicians round the clock; the transmission of EKG's and EEG's by means of a dataphone; the use of closed circuit T.V. to conduct neurological examinations and to transmit EEG's; and computer analysis of EKG's and EEG's.

The nurse-specialists who serve as patient advocates, provide health education to patients and their families, assist in home planning and who provide the follow-up care to groups of chronic patients on the ambulatory service at the Neurological Institute in New York illustrate one innovative utilization of alternative personnel. A different use of a nurse by a neurology service is being made on the neurology service at the Mayo Clinic where the nurse's responsibilities include history taking and, where necessary, the general physical examination.

An example of the combined use of technology and alternative personnel is illustrated by the program at Kings County Hospital, Brooklyn, which employs a specially trained nurse to administer a patient screening interview, to feed the data to a remote access computer through a terminal and, on the basis of the results of the computer analyses, to triage patients. The Ambulatory Care Project at Beth Israel Hospital, Boston, employs minimally trained paramedical personnel, using a precisely phased protocol and computer analysis of data, to triage ambulatory patients with new symptoms and to follow up on chronic patients.

These particular efforts are only a few of the many now being taken. It is too early to predict which of the many innovations now being tested will become standard practice in health care delivery. Traditionally, however, American medicine has placed a great premium upon the development and monitoring of diagnostic and therapeutic innovations, upon the swift dissemination of information on these innovations and upon the education of health care professionals in the use of these techniques. At this point in time, when the demands for and cost of health care are so great, a similar premium needs to be placed upon innovations in health care delivery.

In addition to novel applications of technology and the creative uses of personnel, conceptual innovations simply involving different approaches to what is already available should also be considered in efforts to enhance the quality and efficiency of neurologic care. Such innovations can range from the application of accepted criteria of efficiency in the utilization of medical resources to the application of existing approaches to novel functions to the articulation of previously implicit goals in order to highlight areas of oversight. A number of proposals of this nature, principles for optimal neurological care, are suggested by the Task Force on Patient Services, among them:

1) There should be rational pooling of neurologic resources within defined diagnostic and therapeutic areas so that duplication of services, particularly of highly specialized and expensive services, without a clear demonstration of both need and expected level of utilization can be avoided.
2) Management of the more common neurologic disorders should be in the community by neurologists based in those communities.
3) Community hospitals should not seek to duplicate either the complex and sophisticated equipment or the personnel resources more appropriate to a specialized neurological center, but should provide the common diagnostic and treatment facilities under the supervision of a community based neurologist.
4) Neurologic centers to provide the ultimate in diagnostic and therapeutic capabilities, staffed by the most skilled personnel having at their disposal the most sophisticated techniques and equipment, should be established to serve as models of care and to help offset the uneven distribution of neurologists in our country.
5) To help upgrade the general quality of neurologic care available, the neurologic center should provide continuing support to the community based neurologist by such means as:

   a. An efficient and economic referral and transportation system.
   b. Educational programs for non-neurologists in the medical community.
   c. Telephone and television consultation.
   d. Traveling consultants, in general neurology and in the neurologic subspecialties, to serve community hospitals on a regular basis.
   e. Assistance to community hospitals so that residency training programs can be established in them under the joint supervision of the neurologic center and the community neurologist.
   f. Training of specialized "neurologic assistants" to perform routine and non-critical tasks and so to increase the efficiency of the practicing neurologist.
   g. Participation by the community based neurologist in direct care activities at the neurologic center to ensure continuity of care for patients.

6) Large metropolitan outpatient clinics which, as presently organized, do not always provide optimal neurologic care should be reorganized to more closely approximate the pattern of office practice.

Chapter III.

Report of the Task Force on Manpower for Research

Manpower for Research

INTRODUCTION

This is a report on manpower resources and needs in neurological research. Although research by neurologists comprises only one facet of neuroscience research, it is a particularly important one. Basic neuroscience research is not and should not be the sole or primary responsibility of neurologists, but clinical research is and will remain so. Thus, research by neurologists represents for those afflicted or concerned with neurologic disease the "pay-off" aspect of neuroscience research and it is of great importance to ensure the continuing involvement of neurologists in all phases of research in nervous system disease.

This report will deal with two major areas:

1) The neurologic manpower resources currently involved in neurological research including a review of selected areas of neurological research activity.
2) The projected need for neurologic manpower for research in 1985.

Currently Available Resources

The analysis of currently available resources in neurological research will, like the review of resources for patient care, adopt a relatively broad approach. It will include an examination not only of neurologists in research but also of the sources, location and nature of the research being carried out. To a large extent, this review is based upon material presented in six appendices:

1) Appendix XI: "The Neurologist as Researcher," primarily an analysis of the data file on neurologists maintained by the American Medical Association's Center for Health Services Research and Development but also including supplementary data.
2) Appendix XII: "Funded Neuroscience Projects, 1971," an analysis of data on two computer printouts provided by the Science Information Exchange and the NINDS.
3) Appendix XIII: "Present Status and Future of Basic Research in Neuroscience," a review prepared by Dr. Clinton N. Woolsey.
4) Appendix XIV: "Neuropathology for the Seventies," a review prepared by Dr. Robert D. Terry.
5) Appendix XV: "Neurochemistry," a review prepared by Dr. Alfred Pope.
6) Appendix XVI: "Biomedical Behavior Research," a review prepared by Dr. Sidney Schulman.

As of 1971, 367 neurologists (11 percent of all neurologists on the A.M.A. file) described their primary professional activity to be research, presumably neuroscience research. Of course, this group comprises only part of all those—neurologists, other physicians, and physical and behavioral scientists—engaged in neuroscience research. For example, data from a Joint Commission survey of neurology programs at 99 medical schools show that 751 neurology department staff members are engaged in research activities. Among neurologists who responded to the American Academy of Neurology survey of members' allocation of time to different professional activities, 57 percent report devoting some part of their professional time to clinical research, 25 percent some time to basic research. And finally, the 1968 *IBRO Survey of Research Facilities and Manpower in Brain Sciences in the United States* lists 373 organizations, 880 research groups and 4,245 researchers as doing work in neuroscience research.

Despite the fact that the 367 research neurologists on the A.M.A. file represent only one segment of all those involved in neuroscience research, they are a particularly important segment. Not only do they, as neurologists, occupy a necessary, indeed a critical role in clinical research but because of their *degree* of involvement in neuroscience research they also represent a disproportionate amount of the total neurology effort in neuroscience research.

Of these 367 neurology researchers, a substantial portion are graduates of foreign and Canadian medical schools, 24 and 4 percent respectively, a total of 28 percent. (Graduates of foreign and Canadian schools comprise 24 percent of all neurologists in 1971.)

The 267 neurology researchers who graduated from American medical schools tend to come from a limited number of schools. Indeed six schools account for 35.6 percent of all American graduates in neurology research. This "productivity" with respect to neurology researchers cannot be explained solely by "productivity" with respect to neurologists in general, these same six schools accounting for only 18.3 percent of all American neurology graduates in 1971.

The report on neurology manpower for patient care suggested that a medical school "atmosphere" can be an important factor in a graduate's choice of neurology as a specialty but it is also possible that medical school "atmosphere" affects choice of professional activity. Thus, certain schools may graduate disproportionate numbers of neurologists, others a disproportionate number of researchers and others, both. Research on the relation of medical school characteristics to specialty and activity choices by graduates might well yield important insights into the factors affecting careers in medicine.

As a group, neurology researchers tend to be younger than all other neurologists. (In turn, neurologists tend to be younger than all other physicians.) This may reflect the fact that the great expansion of neurology and of both research and research opportunities in neurology are relatively recent phenomena.

Compared to other physicians, neurologists tend to congregate in large metropolitan areas but research neurologists tend to do so even more, four out of five located in the largest cities. This may be explained in good part by the practice settings in which they work. More than 57 percent of research neurologists work in medical schools (and almost all medical schools are in the largest standard metropolitan statistical areas) and at least another 9 percent of the researchers are located in university hospitals or hospitals affiliated with medical schools. It should also be noted that neurology researchers nd funds for neurology research tend to flock together, the rank order correlation between percentage of neurology researchers and NINDS research awards for each of the nine census divisions giving a value of +.88.

Given this association, it is not surprising that the retrenchment in federal support for both training programs and research efforts between 1968 and 1971 has been accompanied by a marked decline in the number as well as percentage of neurologists primarily engaged in research. In 1968, 17.4 percent of all neurologists were primarily engaged in research; in 1971, 11.5 percent. Even more, there was a decline of 18 percent in the actual number of neurologists engaged in research, from almost 500 research neurologists in 1968 to less than 400 in 1971.

If only a decline in the proportion of all neurologists engaged in research had taken place, it could be argued that, the educational and research infrastructure requisite for the expansion of neurology having been developed, it was appropriate that proportionately more of recently trained neurologists were devoting themselves to patient care than had been the case previously. And given both the need for patient care neurologists and the proportionately greater number of neurologists in research compared to other specialties, the argument has a certain face validity. However, the decline is also in the absolute number of neurologists primarily engaged in research and, whatever the explanation is, this represents an ominous development for neurological research and even more for the clinical benefits, e.g. in the treatment of parkinsonism, deriving from such research.

Rather obviously, given this discussion, research neurologists do not function in a vacuum but in a context, a significant element of which is the goals and priorities of funding agencies. Some data on the funding of research projects in the neurosciences during 1971 were obtained from the Science Information Exchange and the NINDS.

Although 173 different agencies were, at a minimum, involved in the funding of neuroscience research projects in 1971, 95 percent of all projects were sponsored by only nine agencies. At least 88 percent of all grants were funded by governmental agencies, with the United States Department of Health, Education and Welfare by far the major source of neuroscience grants, 63 percent of all grants (58 percent of all grants funded through the Public Health Service and 5 percent through the Social and Rehabilitation Service). It is worth noting that important as NINDS is in the funding of neuroscience research, still it funds at most only 31 percent of all neuroscience projects. (It is impossible to give a precise figure because of the nature of the data made available to us.)

The overwhelming majority of grants, more than 90 percent, were to researchers working in the

United States. (A significant number of projects were located in Canada but most of these were funded by the Canadian Government.)

Within the United States, the Middle Atlantic and Pacific states are the leading recipients of neuroscience research grants. (This is only after a total of 383 intramural grants, all in Bethesda, Maryland and Washington, D.C., are excluded from the analysis; if these are included, the South Atlantic States are the leading recipients of funded neuroscience projects.)

Medical schools are the primary institutional recipients of NINDS grants, 55 percent of the total. (Because the NINDS provided more data than did the SIE, it was possible to examine NINDS grants in greater detail than was the case with the projects listed by the SIE.) If medical school-affiliated hospitals and research institutes are included in the medical school total, then 61 percent of all NINDS grants are to medical schools. The only other significant institutional recipient of NINDS grants are universities, 32 percent of the total. Even here, medical school ties make a difference: universities with medical schools receive 22 percent of all grants, other universities, only 10 percent.

Whether this difference comes about because many medical school projects could not be identified (a possibility, given the limitations of the data) or because universities with medical schools tend to have more extensive biological science programs, or because some other factor cannot be definitely determined. However, some other findings are relevant to this issue. The leading institutional recipients on both the NINDS and SIE listings were identified. The ten leading recipients of NINDS grants, less than 4 percent of all institutions receiving NINDS support in 1971, account for 23 percent of all grants; the ten leading recipients on the SIE listing, 1.6 percent of all institutional recipients, account for 17.6 percent of all grants. Possibly because funding agencies tend to concentrate funds in a limited number of institutions, frequently medical schools and presumably those which are defined by them as centers of excellence in neuroscience research, there is a great deal of overlap among the institutional leaders on both lists. And while an appreciable overlap among the leading institutional recipients of research grants, leading "producers" of neurologists and leading "producers" of research neurologists may be expected, it is worth noting that this overlap also extends to the leading institutional "producers" of neuroscience doctorates identified in H. W. Magoun's survey, "Neuroscience Doctorates in the Sixties and Implications for the Future."

(These overlaps among institutional "leaders" suggest that the impact of medical school "atmosphere" upon choice of neurology as a specialty and of research as the primary professional activity may be linked not only to characteristics of the medical school and of its faculty but also to those of the university. A study, possibly some form of regression analysis, of the interrelationships among specialty choices and professional activities by medical school graduates, the distribution of the medical school faculty by specialty, professional activity and research interests and the extent and nature of activities in the biological sciences in the university might well contribute significantly to an understanding of the factors affecting both career choices by medical school graduates and the distribution of funded research projects.)

The distribution of grants in relation to the professional degree of the principal investigator was also studied. It was possible to identify the professional degree for 691 principal investigators representing 55 percent of the 1,259 NINDS grants located in the United States: of the 691, 328 (47 percent) are M.D.'s, 52 (8 percent) have both an M.D. and Ph.D., 296 (43 percent) are Ph.D.'s and 15 (2 percent) have other degrees.

Finally, an attempt was made to analyze neuroscience grants in terms of their focus, specifically whether or not they are directly concerned with clinical problems. Each project on both the SIE and NINDS listings was examined to determine whether or not the project, on the basis of its title, dealt with a specific clinical entity. Of the 4,152 projects on the SIE listing, 304, 7 percent of the total, referred to a clinical entity in the title; of the 1,289 projects funded by the NINDS, 87, also 7 percent, did so. Thus, insofar as such measurements are valid indicators, the NINDS does not differ from other sources of neuroscience funding in the proportion of its grants specifically focused upon particular disorders. However, the two listings do differ with respect to the clinical problems referred to in the title, the most striking difference being with respect to stroke, 43 percent of all NINDS "clinical" projects concerned with that problem while only 14 percent of the SIE "clinical" projects deal with it. Given this and the other less dramatic differences in this phase of the analysis, it would appear that the NINDS and all SIE funding agencies choose similar recipients for their neuroscience research grants but direct their funds toward dissimilar clinical problems. (It is also worth noting that 76 percent of the principal investigators of these "clinical" projects are M.D.'s compared to 55 percent for all projects, a finding which emphasizes the key role of the neurologist in clinical research.)

Of course, the context in which research neurologists function includes more than the goals and priorities of funding agencies. The research "climate," i.e., the consensus in the field as to which areas have shown and are showing the most promising and exciting developments or which areas are most likely to do so in the immediate future, comprises another important element of that context, affecting the decisions of both researchers and funding agencies. In order to provide some idea of the current climate in neuroscience research, reviews of major areas in the field were prepared by members of the Joint Commision Task Force on Research and are included as Appendixes XIII—XVI.

Projected Needs for 1985

Estimates of manpower "need" for research, like those for patient care, require the quantification of value commitments and empirical assumptions. The differences are in the nature of the specific values and assumptions involved. Unfortunately, while it is possible to specify the assumptions and values which comprise the equation for estimating manpower "needs" in research, it is not possible, at this time, to actually work out the equation.

"Need" for research neurologists can be defined as a two factor equation based upon:

1) the manpower required to maintain an organized capacity for research, and
2) the manpower required to meet specific research goals.

With respect to the first factor, the manpower required to maintain an organized capacity for research, we lack the data which would enable us to attach even rough quantitative weights to the specific elements involved. An organized capacity for neurological research implies a complex system which includes not only neurologists but other highly trained professionals, support staff, ongoing research programs, elaborate and sophisticated equipment, facilities, etc. It seems safe to assume that this system must be of a certain minimal size if it is to be capable of maintaining and perpetuating itself, that is, able in the normal course of events to attract and recruit replacements for those who leave because of retirement, death or other reasons. (It also seems reasonable to assume that it is desirable to maintain such a minimal research capacity in neurology and in other complex areas so as to ensure that changes in priorities can be implemented by expansion of an existing system rather than by a recreation of one.) However, we lack two critical pieces of information: the size such a system must reach before it becomes capable of perpetuating itself; and the necessary ratio of the system's elements (neurologists, other professionals, etc.) to each other. Given the significant role of research activity in our society, the extent of our investment in research efforts and the frequent changes in the priorities given different areas—these changes often involving fairly massive reallocations of resources—attempts to obtain a better understanding of what is required to maintain an organized research capacity in specific areas should be defined as a priority concern.

With respect to the second factor in the equation, the manpower required to meet specific research goals, the problem is not only a lack of knowledge but also the absence of an explicit consensus by which we can determine the nature of the relevant values. It is possible to discuss research per se in the abstract, but from a practical point of view, i.e., in terms of the allocation of resources and the actual conduct of research activities, investigators do research only in relation to specific questions and problems. In order to determine manpower "needs" for neurological research, it is first necessary to determine:

1) which of the many questions and problems in neurology are to be given priority; and
2) what are the manpower requirements for each of the specific research programs.

Given this approach, manpower needs for neurological research can to a large extent be viewed as a modular construct. Although such a modular approach might be inappropriate where the goal is knowledge for its own sake, it appears to be an appropriate model particularly for manpower needs in neurological research and in other clinical areas; because of its built-in definition of priorities, the modular approach can help focus available resources most efficiently upon particular clinical problems.

If priorities are desirable, still those priorities must be determined. There appear to be at least two sets of criteria which must be taken into account in determining these priorities: clinical consequences and research climate.

If the ultimate justification of neurological research is better patient care, then the clinical consequences of disease entities must, at the least, be considered in terms of three dimensions:

1) magnitude, i.e., the sheer number of people afflicted;
2) severity, i.e., the degree of personal impairment and suffering brought about by the disease; and
3) social cost, i.e., the direct cost of health care

plus the loss to society resulting from the inability to participate in the economy because of the illness.

(It is also possible to include cost to the family as a fourth dimension but this cost can be assumed to be in large part a reflection of severity and the direct costs of health care.)

The second major criterion, the research climate, refers to the consensus among researchers as to which areas are, at this point in time, most likely to be productive, i.e., to yield substantively significant developments in the near future. Indeed, one of the functions of Appendixes XIII—XVI, the reviews of selected research areas, is to indicate the current "research climate" in these areas. (Sample surveys of research neurologists would provide a relatively simple mechanism for obtaining quantitative evaluations of the research climate for use in the establishment of priorities.)

It should be noted that insofar as research priorities are determined by the research climate and the climate is determined by researchers, clinical criteria may not be given sufficient weight in the determination of research priorities. It would be desirable, therefore, that efforts be made to ensure that those neurologists who are primarily concerned with patient care are significantly involved in the determination of research priorities. (The importance which the Commission attaches to this is, in small part, evidenced by Appendix XVII, "Neurological Research as Viewed by the Practicing Neurologist," one neurologist's view of what our research priorities should be.)

Once specific research priorities, particularly research priorities with respect to defined clinical problems are established, a rough but adequate determination of manpower and other needs can probably be reached on the basis of existing management techniques.

The emphasis of the Joint Commission in this area has been upon first steps, the identification of the factors and elements which must comprise an equation for estimating manpower needs for research neurologists. But much which was beyond the capacity and resources of the Commission remains to be done, including:

1) a review by the wider community of neurologists and research scientists of the elements proposed for inclusion in the manpower equation;
2) collection of necessary empirical data, e.g., with respect to maintenance of an organized capacity for research, as a basis for quantification;
3) assignment of numerical weights to the value-based criteria in the equation;
4) selection of specific research priorities; and
5) determination of manpower needs.

Because of the delays inherent in developing and implementing this methodology, a somewhat different approach was also taken (Appendix XVIII, "Report of the Task Force on Research"). In order to obtain an approximate idea of "needs" for research neurologists, the heads of departments of neurology were surveyed with respect to their current faculty (1971), plans for the immediate future and perceptions of needs by 1976–1977. As of December 1971, 702 faculty members in departments of neurology were reported as engaged in research activities. (The extent of this involvement was not determined.) If the rate of increase between 1971 and 1976–1977 which was estimated as necessary by department heads obtains and continues, it appears that there will be a need in 1985 for 1,594 neurology faculty who will devote some time to research, more than twice the 1971 total.

Chapter IV.

Report of the Task Force on Manpower for Education

Manpower for Education

INTRODUCTION

If there are to be sufficient neurologists to meet the needs for patient care and research, there must be the resources, teachers and programs, to prepare them. This report will look at three areas:

1) The neurologic educational resources currently available.
2) The capacity of the current system to meet projected manpower needs by 1985.
3) Issues in neurologic education.

Current Educational Resources

To a large extent, neurological education tends to be defined as residency training in neurology and to a large extent this is a valid definition. The number of neurologists available depends upon the residency training programs which recruit and prepare future neurologists. However, initial exposure to and training in neurology begin in medical school and the nature of this training and the "atmosphere" in which it takes place may well influence the number of physicians who choose careers in neurology.

Between 1966–1967 and 1971–1972, the number of medical schools increased 21 percent, the number of students by 27 percent and the number of graduates by 23 percent. (Most of the data presented in this section are derived from Appendix XIX, "The Neurologist as Educator.") During this five-year period, the number of budgeted faculty positions for neurology departments increased by approximately the same rate, by 24 percent, from 610 in 1966–1967 to 760 in 1971–1972. This increase compares unfavorably with the 57 percent increase in the number of budgeted faculty positions for all clinical departments.

However, the limited expansion of neurologic resources in medical schools contrasts sharply with developments in residency training. The number of approved neurology residency programs increased from 98 in 1966 to 111 in 1971, a 13 percent expansion, while the number of approved residency programs in all specialties declined from 4,849 in 1966 to 4,667 in 1971, about a 4 percent decrement. The number of neurology residents on duty as of September 1 increased from 541 in 1966–1967 to 854 in 1971–1972, an increment of almost 58 percent compared to one of roughly 33 percent for all specialties.

This discrepancy between developments in medical schools and in residency training may reflect a number of factors, the build-up of neurology departments prior to this time frame or the influence of funded residency programs as a determinant of residency choice or some other variable. Unfortunately, the data available are such that any answer must be speculative.

Wherever the locus of neurological training, medical schools or residency programs, such training requires teachers. Although such teachers do not have to be neurologists, e.g., basic science faculty in medical school, the focus here is upon the neurologist as educator. The A.M.A. file characterizes physicians by their principal professional activity: patient care, medical teaching, research, administration and a residual category. The category of medical teaching included only 182 neurologists in 1971. There is a large gap between the number on the A.M.A. file, the 760 budgeted filled full-time faculty positions noted earlier and the 1,023 neurologists and "neurological associates" reported as being "regularly engaged in either basic science or clinical science teaching in the broad field of Neurology," in a 1971 survey of neurology departments (Appendix XVIII, Report of the Task Force on Research). It should also be noted that among neurologists responding to the Academy survey (Appendix I, "Neurology Manpower in the United States, 1971"), 91 percent reported devoting at least some time to teaching.

Of course, if all neurologists on the A.M.A. file who indicated their principal activity to be research and/or administration in a medical school or affiliated hospital are included among the teachers then the gap between the A.M.A. file and other estimates is reduced, though not eliminated. However, the data discussed here refer only to those neurologists who list teaching as their principal professional activity.

First, the 182 neurology teachers in the A.M.A. data bank are less likely to fall into either the younger or older age categories than colleagues. Fewer than 9 percent are 55 years of age or older compared to 15 percent of all other trained neurologists; similarly, only 12 percent of the teachers are under 35 years of age compared to 18 percent of all other trained neurologists. On the one hand, young and inexperienced physicians are not likely to be placed in a teaching role. On the other hand, the expansion of neurology has been a recent phenomenon and recruitment of teachers has of necessity come from those entering the field since World War II.

With respect to educational background, about 21 percent (38) of the neurology teachers were graduated from foreign or Canadian medical schools. Among the 144 graduates of American medical schools, 65 percent were graduates of privately owned schools. Almost one half (68) of all American graduates come from only thirteen medical schools. The three leading producers of neurology teachers are Columbia University, the University of Minnesota and Harvard University. If the producers of neurology teachers are looked at from a somewhat different point of view, that is, which school shows the highest proportion of their neurology graduates entering teaching, the three leaders are Tulane University, the Medical College of Wisconsin and the University of Minnesota.

Where are the neurology teachers now? Three-fourths of them (138) are in the largest cities and slightly over three-fourths are based in medical schools or affiliated hospitals. The distribution of neurology teachers by state is, to some extent related to the distribution of medical students by state and strongly related to the distribution of residents by state. This may reflect the fact that neurology residents must be taught by neurologists while the volume of neurology taught by neurologists in medical schools may be relatively small.

About 60 percent (108) of the 182 neurology teachers have been certified by the American Board of Psychiatry and Neurology; an additional eight are certified by other specialty boards but 66 (36 percent) had not been certified by any specialty board as of the date the A.M.A. file was copied for our use. The fact that over one-third of those who describe their primary professional activity as teaching are not certified is worth noting. A teacher of neurology is expected to be an outstanding clinician as well as a good pedagogue and a competent researcher (Appendix XXIII, "Training of the Academic Neurologist") and certification by a specialty board is generally held to be one of the major indicators that a physician is considered to be an outstanding clinician by his peers. It is also a criterion about which many medical schools and hospitals are concerned.

Because of these considerations, this group of 66 was studied in some detail. Twenty four (36 percent) of the 66 are graduates of foreign medical schools; among the 116 teachers who are board certified, only 12 percent are graduates of foreign schools. Nineteen of the 66 (29 percent) are 34 years of age or younger, while among those who are board certified only 3 percent are under 35. And 15 percent of the non-certified teachers are women, compared with only 3 percent of those who are certified.

Manpower for Education, 1985

There appear to be at least four approaches which can be taken to determine manpower resources and needs for neurological education in 1985. The first of these approaches rests upon the "anticipated needs" for neuroscientists by medical school departments of neurology. In 1971, the Task Force on Research of the Joint Commission sent out a questionnaire on neurology manpower to 98 neurology department chairmen and to the deans in those seven schools which did not have chairmen; 99 questionnaires were returned (Appendix XVIII, "Report of the Task Force on Research"). The analysis of the data yielded the following results:

1) 1,023 members (including neurologists and "neurological associates") of neurology departments are regularly engaged in the teaching of some aspect of neurology.
2) 227 additional staff members are or will be needed during the next two years.
3) An additional 264 positions in "both research and teaching should be available (five years from now) . . . beyond the numbers mentioned in questions 1, 2."

Thus, the anticipated manpower needs of neurology departments for 1977 total approximately 1,514 neuroscientists. If the manpower needs of these departments expand at the same rate from 1977 to 1985 as they are expected to expand from 1971 to 1977, then a total of approximately 2,200 neuroscientists will be required by 1985, roughly double the numbers available in 1971.

A second approach is determining the probable

TABLE 1

Neurology Residencies

Year	Offered	Filled [1]		Filled by Foreign Medical Graduates	
		Number	Percent	Number	Percent [2]
1961	527	410	78	N/A	N/A
1962	575	441	77	N/A	N/A
1963	634	503	79	110	22
1964	628	501	80	120	24
1965	679	562	83	137	24
1966	702	541	77	146	27
1967	760	584	77	161	28
1968	837	684	82	179	26
1969	(827) [3]	N/A	N/A	N/A	N/A
1970	945	781	83	228	29
1971	993	854	86	252	30

[1] Residents on duty in September of the given year.

[2] Percent of filled residencies occupied by foreign graduates.

[3] No data were published on residencies for 1969. This figure is taken from JAMA, Vol. 206, No. 8, 1968 and is the number estimated at that time that would be offered for 1969–70.

Source: J.A.M.A., education issues 1962–72.

capacity of the system for training neurologists. Since the capacity of the educational system to prepare neurologists is directly linked to residency training, residency training programs will be the focus here. (The basic data on which this analysis is based are presented in Table 1.) As of September 1971, 993 residencies were offered by a total of 88 training programs. Of these 993 positions available, 854 (86 percent) were filled. Further, of the 854 trainees, 252 (30%) were graduates of foreign medical schools. Given that nearly all neurologic training programs are three years in length, the current educational system is producing approximately 284 neurologists a year. Because of the relatively young age distribution among neurologists in the United States, this is almost equal to the annual net addition of neurologists to the field.

If we assume that the number of filled residencies will remain constant at the 1971 number (854), that the length of residency training programs and of the attrition rate among residents will also remain constant so that there would continue to be an uncorrected annual increment of 284 neurologists, and that attrition in the field because of retirement and death will equal the total number of currently practicing neurologists who will be 64 years of age or older in 1985 (643), then the total of neurologists in 1985 will be 6,740, an increase of 98 percent over the 3,398 in 1971.

If a somewhat different first assumption is made, viz., that the number of filled residency positions will increase 1.6 percent annually to a total of 1,065 in 1985 (125 percent of the 1971 total), then the total number of neurologists in 1985 would be 7,265 an increase of 114 percent over the 3,398 in 1971.

An average expansion rate of 1.6 percent, or an even higher rate, appears both modest and feasible given the past performance of the system (Table 1). Between 1961 and 1971 a far more dramatic expansion took place. The total number of residencies offered increased 466, from 527 to 993 an 88.4 percent increase for the period. For the five year period 1966–1971, the increase was 291, from 702 to 993, an increase of 41 percent. It is worth noting that in spite of the increase in residencies offered, an average of 47 new positions per annum for the decade, the percentage of unfilled residencies declined, particularly in the years 1966–1971. Of course, this increase in the number of filled residencies depended in part upon the increase, both absolute and relative, of foreign medical graduates coming into neurology.

Extrapolation of the 1961–1971 figures to 1985 would lead to 2,140 residencies offered and 1,715 filled, 450 by foreign medical graduates. Extrapolation of the figures from 1965–1971 to 1985 would lead to 2,345 residencies offered and 1,900 filled, 530 by foreign graduates. Of course, such a rate of expansion is neither likely nor desirable. But it does suggest that the educational system could, if necessary, meet any reasonable need for neurologists.

A third approach, one which directly relates the amount of neurological teaching required to produce a specified number of new neurologists, can also be used if two assumptions are made: one, that the results from the American Academy of Neurology survey on neurologists' use of their professional time can be extrapolated to all trained neurologists; and two, that the nature of teaching in neurology will continue as is.

If these two assumptions are made, then the total amount of time devoted to teaching by trained neurologists during the course of a 48 week year is somewhat less than 700,000 hours. If this total is divided by 284, the number of newly trained neurologists being produced each year at this time, then the addition of one neurologist to the field requires some 2,400 hours of teaching per year by neurologists. In other words, under the present educational system, the production of one new neurologist requires that four fifths of the total professional time of a trained neurologist be devoted to teaching. Thus, to produce a total of 350 neurologists a year, additional teaching representing the efforts of 50 full time trained neurologists is required.

The fourth approach which could be taken, paralleling the ones taken with respect to patient care and research, would entail the development of an equation for estimating "need" for neurology educators. The components of such an equation would include:

1) Standards for undergraduate education, i.e., the desirable ratio of neuroscience faculty to students to ensure adequate recruitment. (This is linked to the general question of medical school "atmosphere" discussed in the patient care and research sections.)
2) Standards for residency training programs, i.e., the minimal ratio of instructors to residents and the minimal ratio of patient beds to residents.
3) A consensual estimate of the number of patient care and research neurologists needed.

The working out in detail of such an equation is desirable for at least two reasons. First, it would provide a mechanism for estimating "need" on an ongoing basis. Second, by entailing an examination of the implicit assumptions prevailing in medical education, the process of developing the equation might well contribute to further rationalization of the process.

Desirable as the development of such an equation might be, the Joint Commission made no effort to do so. The concern of the Commission is not with the development of methods per se. Given the fact that the potential capacity of the educational system is sufficient to realize any manpower goals likely to be estimated, the development of such an equation is a luxury rather than a necessity in light of the Commission's charge. Further, because of the many significant and sensitive educational issues inherent in the quantification of educational standards, it would appear both necessary and desirable to have this carried out by a body more representative of the institutions and groups involved in neurologic training, these including the trainees themselves.

Issues in Neurologic Education

Education involves more than resources and numbers; it also involves questions and decisions as to the organization and utilization of these resources. The Task Force on Education of the Joint Commission addressed four major issues in neurologic education:

1) Appendix XX, "Undergraduate Medical Education in Neurological Sciences."
2) Appendix XXI, "Specialty Training in Neurology."
3) Appendix XXII, "Continuing Education in Neurology."
4) Appendix XXIII, "The Training of the Academic Neurologist."

Undergraduate medical education in the neurological sciences serves at least two major functions: contributing to the flow of physicians into neurology by exposing students to the field and equipping those who are interested to meet the demands and requirements of residency training; and preparing all other students to recognize neurologic disease, to diagnose and treat the more common neurologic problems, to refer cases appropriately to a neurologist and to be able to follow up treatment recommendations by the neurologist. Hence, all medical students require some minimal contact with neurology.

The ability of undergraduate medical education to fulfill these functions depends upon the availability of faculty to develop and implement the curriculum. Such faculty require extensive preparation in training centers of excellence. The number of centers required to meet the needs of medical schools and of other training programs and, given the lack of assured federal support, how these centers may be funded are among the major questions currently facing American neurology.

In addition to the problems engendered by funding developments, the ability of undergraduate neurologic education to serve its two major functions is being challenged by changes in the pattern of medical education. The curriculum reforms of the 1960's have led to reduced requirements in the basic sciences (neuroanatomy, neurophysiology, neuropathology and the biochemical and pharmacological aspects of the nervous system) and in clinical neuroscience training (the clinical clerkships in neurology and neurosurgery). In addition, the elimination of internships will further reduce the opportunity for physicians to work with and learn from patients with neurologic disease.

In light of these changes in medical education and of emerging developments in health care delivery, the Task Force on Education proposes a number of guidelines for undergraduate neurologic education, among them:

1. Where innovative "neurobiology" courses are being introduced to replace separate courses in neuroanatomy, neurophysiology and other basic neurological sciences, this effort should be preceded by adequate planning and followed up with systematic monitoring and evaluation.
2. In order to rationalize the educational process, attempts should be made to eliminate inappropriate or duplicatory lectures and lecture material by an augmented use of self-teaching audiovisual technology (slides, audio tapes and video tapes) on neuroanatomical and neurophysiological concepts so that students can cover fundamentals in the library.
3. In order to make the links between basic neuroscience material and clinical practice more explicit, there should be greater utilization of small group teaching, by clinical faculty and house staff as well as by pre-clinical faculty, the focus of such teaching not only on the review and supplementation of library material but also upon its clinical relevance.
4. In order to enhance the neurological sophistication of medical students and to facilitate the recruitment of physicians into neurology, the undergraduate curriculum should include exposure to neurology in each of the four years.

Residency training is, of course, the key point in the preparation of the neurologist. Neurological training involves both the acquisition of a large body of knowledge relating to many disease conditions and supervised experience in diagnosis and therapeutics. Past observation has suggested three years as the minimum time required for residency training. Given what must be taught in residency training, it does not appear feasible or desirable either to reduce the time required or to increase the material covered. Until recently, the M. D. degree followed by a one-year internship was considered the minimum requirement for entering training. The internship, which is scheduled to become a part of specialty training, has traditionally provided the trainee with the basic skills and values required of a physician.

The elimination of the internship is a major problem which cannot be ignored. Given the knowledge, experience and skills which must be absorbed in the residency, it appears highly undesirable for medical students to enter neurology without a transition year in which exposure to diagnosis and treatment is provided. Therefore, it appears necessary for neurology residency programs to develop the means for providing adequate patient care experience before actual training in neurology is begun. And, indeed, one year of general medical training has been established as a prerequisite for embarking upon neurological training.

Continuing education is the process "of keeping physicians acquainted with the appropriate body of medical information as it accumulates in their entire professional lifetime following their formal training." Continuing education in neurology has at least two target populations:

1) Those physicians who have had specialty training in neurology and are either Board eligible or Board certified in that specialty;
2) Those physicians whose clinical load will include patients requiring neurological screening or treatment. (This includes both primary care physicians, e.g., family specialists, and those whose specialties are in some way related to neurology, e.g., internal medicine, pediatrics or orthopedics.)

With respect to continuing education for neurologists, opportunities for maintaining and enhancing professional competence exist in a large number of specialty publications in neurology, the annual intensive review courses offered by the American Academy of Neurology and the continuation courses in the neurosciences given by or involving medical schools. (At least three-quarters of American medical schools report participation in continuing education courses in the neurosciences.) In short, it would appear that sufficient resources for the continuing education of the neurologist already exist.

However, opportunities available are not the same as opportunities taken. Most, if not all neurologists utilize the continuing education resources available. But given the importance of such participation for ensuring the provision of adequate health care, reliance solely upon individual effort, judgment and conscience to maintain professional skills appears out of step with current and justified attempts to introduce formal accountability procedures into professional practice. Thus, it is recommended that the national neurological organizations take steps to assess the evidence of the neurologist's competence on a continuing basis.

Continuing education programs for primary care physicians and specialists in fields related to neurology appear far less adequate. A number of existing programs appear unsuccessful in their attempts to reach out to physicians, in part because they are often seen as offering material different from what the practicing physicians believe their needs to be. Further, efforts to enhance continuing education programs are probably impeded by the fact that the rewards for postgraduate teaching are meager. To deal with these problems in continuing education, the following steps are proposed:

1) The introduction of systematic attempts to survey physicians to determine the nature of their practices, the degree to which they encounter neurological problems (and of what type), whether the physicians feel they need continuing education and in what areas and, if so, how they believe it might best be delivered;
2) The formalization of postgraduate teaching as a legitimate, prestigious and rewarding activity for medical school faculty;
3) The development of greater cooperation among the specialties so that steps can be taken to establish minimal standards of care and to define these standards, the role of continuing education in helping to meet these standards, and to gain the participation of practitioners in programs of continuing education. (These are concerns shared by all medicine and should be dealt with as a general problem, not piecemeal, specialty by specialty.)
4) In order to eliminate duplication of efforts, there should be a mechanism by which the medical schools, hospitals and professional groups in a geographical area coordinate their postgraduate teaching programs.

It is not only neurologists and other physicians who must be trained but also the academic neurologist who is responsible for that training. Historically, the training of the academic neurologist, as of the academic physician and indeed of all who teach in higher education, has been a matter left to take care of itself. The Task Force on Education attempted to identify the nature of and demands upon the role of the academic neurologist and, on the basis of this analysis, to develop standards or criteria for the training of the academic neurologist.

The Task Force identified four major criteria. The first of these is patient care: if the academic neurologist is to be an effective teacher and role model for students, residents and practitioners, the overwhelming majority of whom are oriented toward clinical practice, he must be a superior clinical physician. Thus, the future academic neurologist should receive at least as much training in patient care as those embarking upon a career of practice.

The second criterion is that of teaching effectiveness. Even though there is no consensus as to the value of the various teaching methodologies, still it seems reasonable to assume that if there is one field where the quality of teaching must be a major concern, it is medicine. Insofar as communication from instructor to student or trainee fails, it may well be the patient who pays the price. Thus, the training of the academic neurologist should systematically include experiences designed to foster teaching effectiveness.

The third criterion is that of research, particularly clinical research competence. The medical school and the teaching hospital have been and will undoubtedly continue to be centers of clinical research if for no other reason than the lack of sufficient patient material at other facilities. And if the academic neurologist is to be responsible for much of clinical research, he should be equipped for this role. Thus, the training of the academic neurologist should include at least two years of involvement in research.

The fourth and final criterion is that of administrative competence. The academic neurologist functions within large and complex organizations concerned with educational, research and service tasks. The nature of the situation is such that the academic neurologist must bear responsibility for the supervision of personnel, for administration, for budgeting and for program planning. The training of the academic neurologist should include preparation for the assumption of these important responsibilities.

Appendix I

Neurology Manpower in the United States, 1971

The Joint Commission on Neurology has, as one of its charges, the provision of information about the demographic and professional characteristics of neurologists and neurologists-in-training in the U.S.A. This report will examine three major areas: 1) the demographic characteristics and educational background of neurologists; 2) their present location; and 3) their professional activities and responsibilities. Such information, on the extent, nature and distribution of neurologic manpower resources as of 1971, is not only of interest in itself but also can serve as a basis for developing policy recommendations for the future. The results of this analysis should provide us with a better picture of the availability and thus quality of care being provided to those with neurological disease and in some cases with a better understanding of what factors may be involved in determining the availability of neurological care.

Source of Data

The American Medical Association's Center for Health Services Research and Development maintains a continuously updated file of physicians in the United States. This file is the single most authoritative source of information on physician manpower. Students in American medical schools are entered in this file upon admission and are followed through their training and practice; graduates from foreign medical schools who come to this country for internship or residency training or to practice medicine are included upon arrival in the United States. The Center donated that part of the file which lists "neurologists" in the form of a computer tape to the Joint Commission. In addition, Center personnel freely advised and aided Commission staff.

This report is based primarily upon an analysis of that file. Physicians are defined as neurologists on the file if they describe themselves as such, even if they have not been certified in neurology by the American Board of Psychiatry and Neurology. There are 3,398 M.D.'s (plus seven doctors of osteopathy) who described themselves to the A.M.A. as neurologists. This group, of whom 1,194 were identified as board certified, comprised slightly less than 1 percent of all physicians in the United States as of December 31, 1971.

Demographic Characteristics & Educational Background

In terms of age, neurologists are generally about five years younger than all other physicians: an average age of 41 years compared to 46 for all M.D.'s, and a median age of 39 as opposed to a median age of 44 for all M.D.'s (Table 1).

Why are neurologists so much younger, i.e., why has there developed a trend in recent years for proportionately more young physicians to choose neurology as their specialty (Table 2)?

Specifying the factors which contribute to career choices by physicians is a task beyong the scope of this study. But one factor, the establishment of the National Institute of Neurological Diseases and Blindness (the predecessor of the National Institute of Neurological Diseases and Stroke), should be noted. The funding of training programs in neurology

TABLE I

Distribution of neurologists [1] and M.D.'s [2] by age

Age	Percent of all M.D.'s	Percent of all neurologists
Under 45	50.9	70.7
45 to 65	36.5	23.3
65 and older	12.5	6.0

[1] 3,398 neurologists in U.S., 1971.

[2] 344,823 M.D.'s in U.S., 1971.

TABLE 2

Graduates of 85 American Medical Schools [1] Entering Neurology

Graduation Decade	Neurology Graduates as Percent of All Graduates of 85 American Medical Schools
1915–19	0.4
1920–29	0.4
1930–39	0.4
1940–49	0.5
1950–59	1.0
1960–69	1.6
1970–71	0.6

[1] Physicians are identified on the A.M.A. file with a unique "medical education number" which includes a code number for the medical school from which each graduated. It was possible to code 91 American medical schools. Of the total of 2,577 American medical graduates, 2,564 (99.5 percent) were graduates of 85 of the 91 schools, eight graduating before 1915. An additional 13 neurologists were graduated from American medical schools which could not be coded.

TABLE 3

NINDB-NINDS Appropriations for Research Training Programs, Selected Fiscal Years

Fiscal Year	Research Training Program Appropriations (thousands of dollars)
1954	504
1957	4,150
1960	8,888
1966	17,757
1969	19,262
1970	17,950
1972	15,158

TABLE 4

Percentage Increases in All Active Neurologists and All Active M.D.'s.

Years	Percent Change in All Active M.D.'s	Percent Change in All Active Neurologists
1968 to 1969	+ 2.2	+ 6.5
1969 to 1970	+ 2.6	+ 7.9
1970 to 1971	+ 2.5	+ 7.9
1968 to 1971	+ 7.6	+ 24.0

(Table 3) very closely parallels the upsurge in the numbers of physicians entering neurology over the years.

The decline in the percentage of American graduates entering neurology after 1969 (Table 2) may reflect the limits of the data; it is possible that the A.M.A. file does not include all 1970–71 American graduates who have chosen neurology because their specialty choices were made after our copy of the file was set up while the base used in computing the percentage was the total number of graduates. However, because of the close relation between level of funding and choice of specialty, it is quite possible that the cutback in training funds after 1969 has depressed the percentage of 1970–71 graduates choosing neurology. When the most recent data become available, the question of whether the percentage of American graduates entering neurology is changing can be answered.

Table 4, which shows the increases in all active neurologists and all active M. D.'s, indicates that if there is a real decline in the percentage of 1970 and 1971 American graduates entering neurology, it had had as yet little effect on the total number by the end of 1971.

(It is possible to calculate these percentages only since 1968 because the A.M.A. changed its classification of physicians in that year; earlier data are, therefore, not comparable.)

Women comprise a slightly higher percentage of neurologists (7.3 percent) than they do of all M.D.'s (6.3 percent) and, on the average, they are a year younger than their male neurologist colleagues (40 vs 41). This may relate to the military service requirement for males. It may also relate to the fact that the choice of neurology as a specialty is, as we shall see, a relatively recent phenomenon among women, even more so than among men. Why proportionately more women enter neurology than enter medicine generally is a question which should be explored in light of the substantial increase in women medical students. (About 17 percent of the 1972 entering class were women, nationwide.)

Of the 3,398 neurologists on the A.M.A. file, 724 are graduates of foreign medical schools, 2,577 are American medical school graduates and 97 are graduates of Canadian medical schools. (The Canadian graduates are considered separately only for interest inasmuch as the requirements they must meet for licensure and certification are the same as those for American medical graduates and the approved residency training programs in Canada have the same status as those in the United States.)

Of the 2,577 American medical graduates, 1,057 were graduates of publicly owned medical schools, 1,507 were graduates of privately owned medical schools and 13 were graduates of schools which could not be identified.

Table 5 shows the increasing number of American schools from which 2,556 neurologists were graduated in the period 1915–71.

The 164 female neurologists who were graduated

TABLE 5

Graduates Entering Neurology (American Medical Schools)

Graduation Years	Number of Schools	Neurology Graduates: Number of Graduates	Neurology Graduates: Percent of All Graduates of These Schools
1915–19	10	18	0.4
1920–29	31	71	0.4
1930–39	48	143	0.4
1940–49	65	300	0.5
1950–59	75	663	1.0
1960–69	85	1254	1.6
1970–71	85	107	0.6
Total, 1915–71		*2,556 [1]	4.9

[1] Excludes 21 American graduates, 11 who graduated before 1915 and an additional ten from unidentified schools.

from identified American medical schools during 1915–71 attended 67 of the 85 schools; 18 schools graduated no women into neurology in that time. The percentage of each graduation decade cohort of neurologists who were women rose from 2.8 in the 1920's to 6.9 in the 1960's and 10.3 in 1970–71. (This last percentage may not reflect the true proportion of women to men. All of the male graduates of 1970–71 would have been subject to military service and might not have chosen neurology as their specialty by the time the A.M.A. file was copied.)

Twelve schools graduated one-third of all American medical graduates entering neurology during 1915–71 and 12 schools graduated one-third of the 1965–71 cohort. Table 6 shows how these two groups overlap.

Table 7 identifies the schools which graduated more than 1.5 percent of their graduates into neurology in the period 1915–71. The *total number* of graduates has been included as well, because some of the schools are so new that they have graduated relatively few students. Thus, the relatively high percentages of their graduates entering neurology should not necessarily be expected to persist on the basis of such brief experience.

If we accept the assumption that the medical school experience influences specialty choice (although there is controversy on this point), then examination of the neurology "experience" (faculty, curriculum, "opportunities to be inspired") at schools which produce a proportionately larger number of neurologists among their graduates might provide useful leads for educators in neurology.

TABLE 6

Schools Graduating One-Third of 1915–71 Graduates and One-Third of 1965–71 Graduates

School	Neurology Graduates, 1915–71 (number)	Neurology Graduates, 1915–71 (percent of American graduates)	Neurology Graduates, 1965–71 (number)	Neurology Graduates, 1965–71 (percent of American graduates)
Pennsylvania	106	4.1	34	4.3
Harvard	104	4.1	19	2.4
Columbia	82	3.2	20	2.5
N.Y.U.	73	2.8	20	2.5
Cornell	68	2.6	26	3.3
Northwestern	63	2.5	16	2.0
Jefferson	63	2.5	20	2.5
U. Chicago	62	2.4	17	2.2
Illinois	62	2.4	27	3.4
Michigan	61	2.4	*	—
Minnesota	59	2.2	*	—
Indiana	52	2.0	20	2.5
Maryland	*	—	26	3.3
Pittsburgh	*	—	19	2.4
Total, 12 schools	855	33.2	264	33.3
All American Graduates	2,566**	100.0	790	100.0

* Not one of the 12 schools graduating the most neurologists in the stated time period.

** Eleven neurologists were graduated from American medical schools before 1915.

TABLE 7

Medical Schools Graduating More Than 1.5 Percent of Their Graduates into Neurology, 1915–71

School	Total Graduates	Neurology Graduates	
	(number)	(number)	(percent of total graduates)
Florida	593	18	3.0
U. Chicago	2245	62	2.8
New Mexico	81	2	2.5
Albany	2000	46	2.3
Albert Einstein	1146	24	2.1
Miami	1028	22	2.1
Cornell	3546	68	1.9
West Virginia	507	9	1.8
Pennsylvania	6209	106	1.7
Harvard	6633	104	1.6
Columbia	5210	82	1.6
U. Virginia	2828	44	1.6
U.C.L.A.	992	16	1.6
85 Schools	277,413	2,556	0.9

About 21 percent of all neurologists (724 in 1971) are foreign medical graduates. In 1970, nine foreign countries contributed more than 10 percent of all neurologists to our pool. Table 8 gives the number from each of these countries and the percentages in patient care and research.

Of the 724 foreign medical graduates in 1971, 11 percent are women, compared to 7.3 percent of all neurologists. There seems no obvious reason for this difference. Since we do not have data on all M.D.'s and other specialists, we do not know if this is an unusual percentage.

One serious gap in our data sources, which is not unique to neurology, should be mentioned here: short of reading and tabulating from the *Directory of Medical Specialists* (which would give information on only about one-third of all neurologists), there seems to be no way to retrieve residency training data for neurologists who have completed their training, even though residency training is thought to be an important determinant of competence and career style.

Present Location

According to the A.M.A. file of neurologists in the United States, there is at least one neurologist in every state except South Dakota. (The file also includes 46 neurologists for whom we do not have an identifiable address.)

There is, as can be seen in Table 9, an uneven distribution by state: 49 percent of all neurologists are located in six states in which there are about 40 percent of all M.D.'s but only about 31 percent of the population.

The six states which have a relative concentration of neurologists have an even greater concentration of board-certified neurologists, as can be seen from

TABLE 8

Neurologists by Country of Graduation and Percentage Distribution in Patient Care and Research, 1970

Country of Graduation	All Neurologists		Neurologists in Patient Care*	Neurologists in Research
	(number)	(percent)	(percent)	(percent)
United States	2361	76.8	77.2	73.0
Canada	89	2.9	2.7	3.6
Foreign Countries	624	20.3	20.1	23.4
United Kingdom	58	1.9	1.8	2.4
India	49	1.6	1.7	1.0
Philippines	41	1.3	1.5	0.7
West Germany	39	1.3	1.2	0.7
Japan	32	1.0	0.8	2.9
Italy	31	1.0	0.9	1.5
Spain	26	0.8	0.7	1.9
Switzerland	25	0.8	0.8	0.5
Argentina	21	0.7	0.7	0.7
N	*3074*		*2386*	*411*

* Includes those in office-based practice, full-time hospital staff and residents.

TABLE 9

Percentage Distribution of Neurologists, M.D.'s and Population in Six States

State	Percent of U.S. Population	Percent of All M.D.'s	Percent of All Neurologists
New York	9.0	13.3	15.9
California	9.8	12.5	12.5
Massachusetts	2.8	3.8	6.3
Pennsylvania	5.8	5.6	5.3
Minnesota	1.9	1.8	4.6
Maryland	1.9	2.9	4.5
Total, 6 States	31.2	39.9	49.1

Table 10. (Illinois has been added to the tabulation because it has more board certified neurologists than Maryland, one of our original six states.)

In the seven states (Table 10), we find 33 of the 85 medical schools from which American-educated neurologists were graduated. Almost all of the great private medical schools and great private clinics are located in these states as well. Quite possibly because neurology is (as we shall see) a research oriented specialty, it is also a university-centered one.

The national neurclogist-to-population ratio is 1.5 neurologists per 100,000 population, when retired and inactive neurologists and those with no known address are subtracted from the total. The range is wide, from 0.2 per 100,000 in Nevada where there is a single neurologist for 489,000 people to 7.7 per 100,000 in the District of Columbia where there are 58 neurologists for 757,000 people. Table 11 gives the number of states with various ratios.

TABLE 10

Distribution of Board Certified Neurologists and Population in Seven States

State	Percent of U.S. Population	Percent of Board Certified Neurologists
New York	9.0	19.1
California	9.8	12.8
Massachusetts	2.8	6.6
Pennsylvania	5.8	5.4
Minnesota	1.9	6.3
Maryland	1.9	2.9
Total, 6 States	31.2	53.1
Illinois	5.5	3.3
Total, 7 States	36.7	56.4
N		*1194*

TABLE 11

Neurologist-to-Population Ratios

Number of "States" *	Active Neurologists per 100,000 Population
20	less than 1.0
15	1.0–1.4
8	1.5–2.0
7	2.1–4.0
1	more than 4.0
National average 1.5	

* Includes 49 states (South Dakota has no neurologist), the District of Columbia and Puerto Rico.

However, there are 340 federally employed active neurologists in the Veterans Administration, Department of Defense and Public Health Service who are not available to care for the general population. There are also 713 non-federal neurologists in training on the A.M.A. tape, including residents and fellows. (It should be noted there are no data on the amount of neurological care which residents as a group provide.) When federal neurologists and trainees are subtracted, the national pool of neurologists shrinks to 2,111 and the neurologist-to-population ratio falls to 1.0 per 100,000 population with a range of 0.2 per 100,000 (Nevada is now joined by Arkansas) to 4.4 per 100,000 in the District of Columbia.

In contrast, the Northern California region Permanente Medical Group in 1970 was programed on the basis of 0.5 neurologists per 100,000 health plan members (defined as full-time physicians or full-time equivalents). Of course, health plan members are somewhat younger than the national population, the percentage of persons 65 and older in this health plan membership for the region totaling 4.2 compared with a nation-wide 9.8 percent.

The 2,111 active, trained non-federal neurologists include 574 researchers, educators and administrators who may provide a substantial quantity of patient care. The assumption is that most of the 574 do, but they obviously cannot provide the same amount of patient care they could were that their chief activity. (It should be noted that in calculation of neurologist-to-population ratios it is not possible to take account of that portion of the civilian population which receives care from V.A., military and Public Health Service neurologists. Our net ratios are therefore below that which actually prevails but probably only by a small percentage.)

Because 27 percent of the pool of active, trained

TABLE 12

Distribution of Population, Non-Federal Neurologists and M.D.'s

Census Region	Percent of U.S. Population	Percent of All Non-Federal M.D.'s	Percent of All Non-Federal Neurologists
Northeast	24.1	31.2	35.9
North Central	27.8	23.8	23.8
South	30.9	25.4	21.4
West	17.1	19.6	18.8

TABLE 13

Ratio of Neurologists* to Population in Nine Census Divisions

Census Divisions	Neurologists per 100,000 Population
New England	2.5
Middle Atlantic	2.2
East North Central	1.0
West North Central	1.9
South Atlantic	1.7
East South Central	0.8
West South Central	1.0
Mountain	1.5
Pacific	2.0
United States	1.6

* Excludes 78 neurologists, 46 for whom no address is known and 32 in Puerto Rico and Canal Zone.

non-federal neurologists (574 of the total of 2,111) are engaged primarily—by their own description—in non-care activities, the percentage of their time devoted to care is significant in any attempt to determine neurologist-hours available to treat neurological patients. The A.M.A. is in the process of collecting data on hours devoted to professional activities but these are not yet available. Data generated by the Joint Commission on this issue are presented in the next section.

Table 12 indicates how uneven the distribution of neurologists is among the four census regions, relative to population. The nine census divisions show a similar maldistribution of neurologists relative to population, as Table 13 demonstrates.

These categories of state, census region and division are solely geographical. It is in the SMSA's or standard metropolitan statistical areas that population density is most clearly shown. An SMSA is defined as a central city which, with its surrounding counties, has a combined population greater than 50,000. For analysis, the largest SMSA's were grouped by size into two categories: those with population in excess of one million and those with population between 500,000 and one million; the smaller ones were combined with rural areas. Not surprisingly, neurology is a big-city specialty, particularly for Canadian and foreign medical graduates (Table 14).

This preference for large-city location extends to neurologists of all ages. (It should be noted that there is almost perfect correlation between age and year of graduation.) Except for 11 neurologists who were graduated before 1915, at least 60 percent of neurologists in each five-year graduation interval are located in SMSA's with more than one million population. Only the graduates of 1930–34 (the worst Depression years) stand out in their locational pattern: 76 percent of them are in the areas of more than one million population.

American graduates were divided into those from publicly financed and those from privately financed medical schools; an examination of their locational preferences (Table 15) shows that graduates of the publicly financed schools are distributed more like the population, though they are still heavily concentrated in the large cities.

Activities and Responsibilities

The American Medical Association divides professional activities into five main categories: Direct Patient Care (which includes residents, unless stated otherwise, as well as office-based practitioners and full-time hospital staff); Medical Teaching, Medical

TABLE 14

Distribution of American, Canadian and Foreign Medical Graduate Neurologists in SMSA's

Population of Aggregated SMSA's	Percent of U.S. Population	Percent of American Graduates	Percent of Canadian Graduates	Percent of Foreign Graduates
+ 1 million	39.2	63.7	73.4	71.8
500,000–1 million	10.7	12.5	6.4	11.8
less than 500,000	50.2	23.8	20.2	16.4

TABLE 15

Distribution of American Graduate Neurologists in SMSA's

Population of Aggregated SMSA's	Percent of U.S. Population	Percent of Graduates of Public Schools	Percent of Graduates of Private Schools
+ 1 million	39.2	55.9	67.9
500,000–1 million	10.7	14.7	10.8
less than 500,000	50.2	29.4	21.3
N		1,057	1,507

TABLE 16

Distribution of Neurologists and M.D.'s by Activity

Activity	Percent of All M.D.'s	Percent of All Neurologists
Direct patient care [1]	83.4	75.5
Medical faculty	1.7	5.4
Medical research	3.2	10.8
Other [2]	11.8	8.3
N	344,823	3,398

[1] Includes residents in training as well as full-time hospital staff members and office-based practitioners.

[2] Includes those in Administration as well as Other.

TABLE 17

Distribution of Active Physicians in Research, Selected Specialties, 1971 [1]

Specialty	Total Active Physicians	Percent in Research
All M.D.'s	318,699	3.4
General Practitioners	56,358	0.4
Medical Specialists	81,926	5.8
Cardiologists	6,016	10.7
Gastroenterologists	1,857	14.2
Internists	46,202	5.6
Pediatric Cardiologists	492	11.4
Surgical Specialists	89,779	1.6
Neurosurgeons	2,721	2.6
Other Specialists	90,636	4.9
Preventive Medicine Specialists	826	11.3
Neurologists	3,317	11.5

[1] These data come from *The Profile of Medical Practice, 1972*, which explains the discrepancy in number of neurologists.

Research, Administration and Other (retired, inactive, unclassified). Table 16 compares neurologists with all M.D.'s according to activity.

At least two points should be noted. First, neurologists are more likely to indicate medical teaching as their primary activity than are all physicians. This may reflect the recent expansion of the field and the need to develop an educational substructure for the expansion. And second, neurology is a research-oriented specialty, indeed second only to gastroenterology in the percentage of its practitioners engaged primarily in research. Proportionately, more than three times as many neurologists are involved in research, compared with all M.D.'s. Table 17 shows percentages of aggregated and selected specialties in research.

With the increasing pressure on physicians to provide more direct patient care in the future and with the drastic decline in federal funds for research, it seems reasonable to expect that the relative emphasis placed on research by gastroenterologists, cardiologsits and pediatric cardiologists, and specialists in preventative medicine as well as by neurologists will be diminishing for an indeterminate period.

Proportionately more women are engaged in patient care than men, as can be seen in Table 18, but the difference is slight. At the same time, women are less likely to be engaged in research or administration.

TABLE 18

Distribution of Male and Female Neurologists by Activity

Activity	Percent of All Male Neurologists	Percent of All Female Neurologists
Direct patient care	75.3	78.3
Of which:		
Trained neurologists	(52.1)	(53.8)
Neurologists still in training	(23.2)	(24.5)
Medical faculty	5.3	5.6
Medical research	11.0	8.8
Administration	2.6	0.8
Other [1]	5.8	6.4
N	3,149	249

[1] Includes retired, inactive and unclassified neurologists.

TABLE 19

Distribution of American, Canadian, and Foreign Graduate Neurologists by Activity

Activity	Percent of American Graduates	Percent of Canadian Graduates	Percent of Foreign Graduates	Percent of All Neurologists
Direct patient care	76.0	70.0	74.7	75.5
Of which:				
Trained neurologists	(54.9)	(48.4)	(43.2)	(52.2)
Neurologists still in training	(21.1)	(21.6)	(31.5)	(23.3)
Medical faculty	5.6	5.2	4.6	5.4
Medical research	10.1	15.5	12.6	10.8
Administration	2.8	3.1	1.2	2.5
Other [1]	5.5	6.2	6.9	5.9
N	2,577	97	724	3,398

[1] Includes retired, inactive and unclassified neurologists.

TABLE 20

Distribution of American, Canadian and Foreign Graduate Neurologists by Practice Setting

Practice Setting	Percent of American Graduates	Percent of Canadian Graduates	Percent of Foreign Graduates	Percent of All Neurologists
Office-based	36.7	40.2	17.8	32.8
Of which:				
Solo	(29.2)	(26.8)	(14.4)	(26.0)
Group	(7.5)	(13.4)	(3.4)	(6.8)
Medical school	21.6	17.5	19.8	21.1
Non-Federal hospitals	21.6	32.0	38.9	25.6
Federal facilities	12.7	4.1	12.2	12.4
Other and Unclassified	7.4	6.2	11.3	8.2
N	2,577	97	724	3,398

Are there differences in the principal activities of American, Canadian and foreign medical graduates? The differences are not large except in the category of patient care, in which there are, relatively, considerably fewer trained foreign medical graduates and considerably more foreign medical graduates in training (Table 19). The assumption is that foreign medical graduates come to the United States for training with the intention of returning home. That 31.5 percent of foreign graduates are in training is not, then, a surprising statistic.

Table 20 shows the practice settings in which neurologists are working. Almost 40 percent of foreign medical graduates are based in non-federal hospitals, compared with about 22 percent of American and 32 percent of Canadian graduates. We do not have data on neurologists in specific non-federal hospitals but if neurologists approximate the pattern of other specialists, the foreign medical graduates are likely to be working in non-affiliated (community) hospitals.

With respect to the finding that only 26 percent of all neurologists are in solo practice, the A.M.A. reports that, on the basis of its findings from the Sixth Periodic Survey of Physicians (conducted in 1970), solo practice is the usual type of practice for physicians over 55. There are relatively few neurologists over 55—12.5 percent compared to 27.6 percent of all M.D.'s. Physicians under 40 are said to be more likely to choose a wider range of practice alternatives.

We tabulated the principal activity, Direct Patient Care, against the alternative practice settings of Office-Based Practice, Residency and Full-Time Hospital Staff for the years 1968–71 using data from the "Distribution of Physicians" series and, for 1971,

TABLE 21

Changes in Number of Patient-Care Neurologists and Patient-Care M.D.'s

	Percent Change 1968–1969	Percent Change 1969–1970	Percent Change 1970–1971	Percent Change 1968–1971
All Patient Care:				
Neurologists	+11.4	+ 8.9	+10.7	+34.3
M.D.'s	+ 3.4	+ 2.9	+ 3.1	+ 9.7
Office Based:				
Neurologists	+11.2	+ 7.4	+11.1	+32.8
M.D.'s	+ 1.9	+ 2.3	+ 2.8	+ 7.1
Full-Time Hospital Staff:				
Neurologists	+ 7.5	+14.4	+ 9.4	+34.4
M.D.'s	+ 2.5	+13.4	+ 5.1	+22.2
Residents:				
Neurology	+14.6	+ 7.9	+10.8	+36.9
M.D.'s	+10.0	+ 1.3	+ 2.5	+14.2

"The Profile of Medical Practice" to achieve comparability among the categories (Table 21). (Data before 1968 are not comparable because the A.M.A. reclassified physicians in that year.) Among the points which might be noted is the fact that year-to-year changes in residents are relatively large, and that they are, expectedly enough, reflected in the year-later changes in full-time hospital staffs. There is also some indication the neurologists may be moving more into the area of patient care than they have heretofore. Finally, the relatively large increase in all full-time hospital staff 1968–71 is an interesting finding which needs explanation.

Little unexpected information comes from examining practice setting relative to location in SMSA (Table 22). Only neurologists in group practice even begin to parallel the distribution of the population and they are markedly underrepresented in areas of less than 500,000 population. All other groups of neurologists are concentrated most heavily in the largest areas, probably reflecting the large-city location of most medical schools. Only ten of the schools listed in the A.A.M.C. Directory, 1971–72, were located outside a large SMSA. (Our SMSA data came, perforce, from a 1967 list. It is possible that even those ten schools might now be located in large SMSA's because the six-year shift in population could have been substantial.)

TABLE 22

Percentage Distribution of Neurologists in SMSA's by Practice Setting

Practice Setting [1]	Population of Aggregated SMSA's		
	+ 1 Million	500,000 to 1 Million	Less than 500,000
Office-Based:			
Solo	63.1	13.4	23.5
Group	43.7	16.2	40.1
Medical School	66.3	12.9	20.8
Non-Federal Hospitals	73.4	10.0	16.4
Other	69.4	10.6	20.0
U.S. Population	39.2	10.7	50.2

[1] Excludes 394 federally employed neurologists and 46 neurologists for whom no address is known.

The 2,564 American graduates of public and private medical schools were related to SMSA's by major activity (Table 23). In percentage of neurologists who provide care (both trained and in training), graduates of public medical schools are divided more evenly, in terms of population, than graduates of private medical schools. Indeed this is true for each area of professional activity. Or, to phrase it somewhat differently, graduates of private medical schools are markedly clustered in the large metropolitan areas whatever their professional activity.

A review of the literature on choice of location ("Distribution of Physicians in the United States, 1971") points out that findings are inconclusive. Some of the factors explored have been "hometown," location of medical school and residency program, income potential, "quality of life," and population growth. The presence of a medical school in the community is positively correlated with the number of specialists settling there.

The data examined thus far have dealt with definitions of primary professional activities. As noted earlier, this leaves unanswered the question of the

TABLE 23

Percentage Distribution of American Graduates of Public and Private Medical Schools in SMSA's, by Major Activity

Activity	Population of Aggregated SMSA's + 1 Million	 500,000 to 1 Million	 Less than 500,000
Direct Patient Care:			
Trained neurologists			
Public	53.0	15.8	31.2
Private	61.9	13.3	24.7
Trainees			
Public	58.6	13.0	28.4
Private	77.3	7.4	15.4
Medical Faculty			
Public	62.7	17.6	19.6
Private	77.4	11.8	10.8
Medical Research			
Public	73.7	8.7	17.5
Private	80.7	5.0	14.4
Administration			
Public	38.5	30.8	30.8
Private	73.3	11.1	15.6
Other			
Public	52.5	8.5	39.0
Private	50.0	10.0	40.0
Total			
Public	55.9	14.7	29.4
Private	67.9	10.8	21.3
U.S. Population	39.2	10.7	50.2

TABLE 24

Hours Worked Per Week

No. of Hours	No. of Neurologists	Percent
0–39	22	2.3
40–49	136	14.1
50–59	268	27.8
60–69	342	35.6
70–79	127	13.2
80–89	52	5.4
90 Plus	15	1.6
Total	962	100.0

amount of time devoted to different professional activities, particularly patient care.

In order to obtain some idea of the time allocations for different professional activities among neurologists, the American Academy of Neurology distributed a questionnaire to its membership in March, 1973. This questionnaire covered three main areas—number of hours worked, number of patients seen and division of time in various professional activities. The choices of professional activities offered were patient care, clinical research, basic research, teaching, administration and "other." (In addition, because of interest in the field of pediatric neurology, respondents were asked to indicate how many of their patients were 16 years or under.)

Approximately 3,100 questionnaires were mailed out in February, 1973 to the entire membership of the Academy; 1,338 (43 percent) were returned by July 19, 1973. Of the returned questionnaires, 376 were unusable for a variety of reasons: chief field of activity was not neurology; the respondent was still a resident; the questionnaire was answered in such a way that it could not be coded; and, in some instances, the respondent was deceased. The data presented here are based upon the responses of 962 neurologists, comprising 31 percent of the total Academy membership (not all of whom, it should be noted, are neurologists).

More than 90 percent of the neurologists in this sample reported working between 40 and 79 hours a week (Table 24). The median number of hours worked per week is 61.6, a figure which is not out of line with the figures reported by other physicians.

Table 25 shows how this sample of neurologists reports distributing their time among various professional activities. Only 37 of them (3.8 percent of the total) report that they devote no time to patient care. Another 41 (4.3 percent) report devoting 10 percent or less of their work week to patient care. Roughly 92 percent of the sample spend more than 10 percent of their time in patient care. It is also interesting to

TABLE 25

Division of Time in Professional Activity

Time %	Patient Care N	Patient Care %	Clinical Research N	Clinical Research %	Basic Research N	Basic Research %	Teaching N	Teaching %	Administration N	Administration %	Other N	Other %
None	37	3.8	409	42.5	718	74.6	87	9.0	371	38.6	845	87.8
1–10	41	4.3	324	33.7	89	9.3	374	38.9	425	44.2	53	5.5
11–25	131	13.6	162	16.8	63	6.5	339	35.2	121	12.6	40	4.2
26–50	199	20.7	48	5.0	63	6.5	136	14.1	34	3.5	15	1.6
51–75	234	24.3	13	1.4	18	1.9	23	2.4	4	.4	4	.4
76–100	318	33.1	4	.4	9	.9	1	.1	5	.5	3	.3

note that nine out of ten report at least some of their time is devoted to teaching, that over half report some time devoted to clinical research, and that three out of five report some administrative responsibilities.

An analysis of the actual hours allocated among professional activities is summarized in Table 26. The 962 respondents on whom we have data report devoting a total of 58,878 hours a week to professional activities. The largest single block of time, 32,046 hours (54 percent of the total), is devoted to patient care, an average of approximately 33 hours a week for each neurologist. Teaching comprises the second largest block, 8,889 hours or 15 percent of the total.

Usable responses were given from 958 of our respondents to the question dealing with how many individual patients (as opposed to visits) they see during the course of a year. The median number of patients seen is 863 (Table 27).

Next, to get some idea of the relationship between number of hours devoted to patient care per year and number of patients seen in a year, the data from 962 neurologists who gave both pieces of information were analyzed.

First, the total number of hours allocated to patient care per year in this sample was estimated by assuming a 48-week work year and multiplying this by the average of 33 hours a week devoted to patient care reported by the group (Table 26). The total number of patients seen during a year by this sample was calculated to be about 830,200. Then the total number of hours allocated to patient care in the year was divided by the total number of patients seen. This yielded a figure of about 1.85 hours (111 minutes) devoted to each patient on the average in the course of the year. This figure is, of course, a rough estimate based upon global estimates by the neurologists in our sample. In addition, it was computed without reference to the number of visits a patient made to the neurologist, the specific problem besetting the patient, or whether contact was in the office or in a hospital setting. In short, the meaning of this figure should be interpreted with caution.

Indeed, all of the findings reported in this paper should be interpreted with caution. This was primarily a descriptive study. The data available did not permit any systematic attempt to explain the findings reported. Therefore, many questions, some explictly raised, others implicit in the results themselves, still remain to be answered.

TABLE 26

Professional activity hours (Interval mid-point categories used)

Activity	Number of Hours Per Week	Percent of Total Hours
Patient Care	32,046	54
Clinical Research	4,586	8
Basic Research	3,545	6
Teaching	8,889	15
Administration	3,804	6
Other	1,258	2
Artifact	4,750	8
Total	58,878	99

TABLE 27

Patients Seen Per Year

Number of Patients	Number of Neurologists	Percent of Sample
less than 100	66	7
100–499	245	26
500–999	234	24
1000–1999	279	29
2000–2999	96	10
3000 Plus	42	4
Total	962	100

(The number of children seen each year by this group is shown in Table 28. The median, for those who see such patients, is approximately 138.4.)

TABLE 28

Children Seen Per Year

Number of Children	Number	Percent
0	138	15
1–99	354	37
100–199	142	15
200–299	105	11
300–499	89	9
500–999	73	8
1000 Plus	54	6
Total	955	101

Appendix II

The National Disease and Therapeutic Index Data

The National Disease and Therapeutic Index (NDTI) is one of the few sources available for national data on ambulatory patients with neurological disorders seeing a physician in private practice. (The National Health Survey also accumulates information on ambulatory patients but uses diagnostic categories which are too broad to be of use to the Joint Commission.) Ascertaining the "actual" ambulatory neurologic caseload of physicians in private practice can help contribute to a determination of neurological manpower needs, the patterns of patient referral, the quality of neurologic care and the incidence and prevalence of neurologic disorders.

Nature of the Data

NDTI obtains its data from a panel of 1,500 physicians in private practice, the panel designed to mirror the geographic and specialty distribution of private practitioners in the United States. This panel maintains a record of patients seen during two specified days in each quarter of the year. Days are so assigned that all days in that quarter are covered. Participating physicians are asked to provide a specific diagnosis for each patient which NDTI codes using the International Classification of Diseases (1955) but modified to achieve greater specificity. From this sample NDTI projects total nationwide patient visits to all private physicians.

The Joint Commission obtained data from NDTI for the samples in the years 1965, 1966, 1967 and 1971. (The samples of patient visits were about 0.02 percent of the projected totals for each year.) The specific data provided by NDTI included:

1. Numbers of diagnoses (both actual number reported and numbers which NDTI projected to national frequencies);
2. Numbers of patient visits for each specific neurological disease; and
3. Cross-tabulations of visits by disease, by age of patient and by specialty of reporting physician.

There are some limitations to these data which should be noted. First, because there are relatively few neurologists in the United States, NDTI usually combines neurologists with psychiatrists in their sampling and analyses and the data from the sub-sample of neurologists are not as reliable as the total NDTI data. Also, the absolute number of visits by patients with neurological diseases to the neurologists in the NDTI sample is small; e.g., in 1971, of the 12,279 visits by patients with neurological diseases to physicians only 118 (1 percent of the total) were to neurologists.

The data provided by NDTI cover 49 neurological diseases. In order to allow meaningful statistical analyses, these 49 diseases were grouped into 17 major disease categories as shown in Table 1.

Table 2 lists the actual number of visits for all conditions, the actual number of visits for neurological conditions, and the proportion of all visits made by patients with diagnoses of neurological conditions. This last represented 4.1, 4.3 and 4.5 percent of the total samples for 1965, 1967 and 1971. (Only partial data were obtained for 1966.)

The Care of the Neurological Patient

Who sees patients with neurological conditions? At least in the NDTI sample, the answer seems to be primarily general practitioners and internists (Table 3). During the four years, approximately 31 percent of the visits by patients with neurologic conditions were to general practitioners, although this reliance upon general practitioners may be declining. The proportion of visits to general practitioners declined from 34 percent to 29 percent in the samples between 1965 to 1971 and the NDTI projections to total visits show a decline from 33 percent in 1965 to 26 percent

TABLE 1

Major neurological disease categories

- Basal Ganglia Diseases
  - Parkinsonism
  - Huntington's Chorea
  - Wilson's Disease
  - Dystonia M. Deformans
  - Sydenham's Chorea
  - Athetosis
  - Dyskinesia
- Cerebrovascular Disease
- Congenital Abnormalities
  - Cerebral Palsy
  - Other Abnormalities—CNS
- Convulsive Disorders
- Dementia
- Diseases of Cranial Nerves
  - Bell's Palsy
  - Blindness
  - Deafness
  - Trigeminal Neuralgia
  - Other Facial Paralysis
  - Other Cranial Nerve Dis.
- Diseases of Peripheral Nerves
  - Charcot-Marie-Tooth
  - Guillain-Barre Syndrome
  - Other Diseases of Peripheral Nerves
- Diseases of Muscle
  - Myasthenia Gravis
  - Muscular Dystrophy
  - Polymyositis and Other Diseases of Muscle
- Diseases of Spinal Cord
  - Dorsolateral Sclerosis
  - Motor Neuron Disease
  - Syringomyelia
  - Other Diseases, Spinal Cord
  - Spondylitis, Spine
  - Torticollis
  - Displaced Intervertebral Disc
- Infective, Parasitic, Inflammatory Diseases
  - Encephalitis
  - Herpes Zoster
  - Meningitis
  - Poliomyelitis
  - Syphilis
  - Other Diseases
- Mental Retardation
- Metabolic Disorders
- Multiple Sclerosis
- Poisoning, Drugs, Other Non-Medicinal Agents
- Trauma
  - Head
  - Spine
  - Nerves
  - Birth Injuries
- Tumors, Brain and Other CNS
- Other Diseases—CNS
  - Migraine
  - Other Diseases of Brain
  - Other Symptoms

in 1971. Internists received the next largest proportion of visits, a four-year average of 14 percent with variations from 13 to 16 percent. General osteopaths received 9 percent of the visits on the average, although utilization of them appeared to decrease between 1967 and 1971. Part-time specialists, who were combined into a single cateogry, received an average of 10 percent of all visits, while neurologists averaged only 2 percent of the sampled visits for neurological conditions. In short, even though visits to non-neurologists may include patients who are making their first call on a physician and who will be referred to a neurologist after screening, it appears that most office-based care of ambulatory patients with neurological conditions is provided by physicians other than neurologists.

Table 4, which compares the four-year average distributions of both projected and sample visits, shows only small differences between the two, further substantiating the conclusion about the limited use of neurologists.

TABLE 2

Sample Visits to Private Physicians

	1965	1966	1967	1971
1) Sample visits, all conditions	259,130	*	251,770	274,429
2) Sample neurological visits	10,653	11,411	10,855	12,279
3) Sample neurological visits as percent of all sample visits	4.1	*	4.3	4.5

* Data not available.

Source: LEA, N.D.T.I. computer runs for Joint Commission on Neurology.

Care of Patients with Specific Neurological Disorders

Thus far the analysis has focused upon all neurological conditions as one entity. What is the situation with respect to specific diagnostic categories? The 49 neurological conditions were, as noted earlier, grouped into 17 categories. The distribution of visits

TABLE 3

Distribution of Sample Patient Visits for Neurological Conditions

Selected Specialists	Percent 1965	Percent 1966	Percent 1967	Percent 1971	Percent 4 Yr. Average
Gen. Pract.	34	31	31	29	31
Internal Med.	14	13	15	16	14
Other Med.[a]	3	4	3	2	3
Psych.	3	3	2	5	3
Neurology	1	5	2	1	2
Neurosurgery	1	7	4	5	4
Pediatrics	4	3	3	4	3
Orthoped. Surg.	5	4	5	7	5
Gen. Surg.	4	4	4	4	4
E.N.T.	6	5	5	4	5
Other Surg.[b]	4	4	6	5	5
P.T. Spec.[c]	10	10	10	9	10
Gen. Osteo.	10	10	10	6	9
Other Osteo.[d]	< 1	< 1	< 1	2	1
Total Number	10,653	11,411	10,855	12,279	11,300

[a] Includes cardiologists, gastroenterologists, dermatologists, allergists.

[b] Includes obstetricians and gynecologists, ophthalmologists, plastic and thoracic surgeons, urologists, proctologists.

[c] Includes part-itime obstetricians and gynecologists, surgeons, all other.

[d] Includes osteopathic surgeons, osteopathic pediatricians, osteopathic obstetricians and gynecologists and all other osteopaths.

Source: LEA, N.D.T.I. computer runs for Joint Commission on Neurology.

TABLE 4

Distribution of Sample and Projected Patient Visits for Neurological Conditions (Averages for 1965, 1966, 1967 and 1971)

Selected Specialists	Percent Sample 4-Year Average	Percent Projected 4-Year Average
Gen. Pract.	31	29
Internal Med.	14	18
Other Med.[a]	3	1
Psych.	3	3
Neurol.	2	2
Neurosurg.	4	6
Pediatrics	3	2
Orthoped. Surg.	5	6
Gen. Surg.	4	5
E.N.T.	5	3
Other Surg.[b]	5	3
P.T. Spec.[c]	10	11
Gen. Osteo.	9	10
Other Osteo.[d]	1	1
Average Number	11,300	65,212,000

[a] Includes cardiologists, gastroenterologists, dermatologists, allergists.

[b] Includes obstetricians and gynecologists, ophthalmologists, plastic and thoracic surgeons, urologists, proctologists.

[c] Includes part-time obstetricians and gynecologists, surgeons, all other.

[d] Includes osteopathic surgeons, osteopathic pediatricians, osteopathic obstetricians and gynecologists and all other osteopaths.

Source: LEA, N.D.T.I. computer runs for Joint Commission on Neurology.

to all physicians and to neurologists by these categories is presented in Table 5. Two points might be noted. First, leaving aside the residual category (other diseases—CNS), roughly 55 percent of visits to physicians by patients with neurological conditions are accounted for by five categories: diseases of the spinal cord, cerebrovascular disease, diseases of the peripheral nerves, diseases of muscle and trauma. If these figures are indeed representative of the realities of practice and if a major goal of education is to prepare for practice, then these figures suggest what perhaps should be the clinical areas of emphasis in the preparation of physicians other than neurologists.

The second point which might be noted concerns differences between neurologists and other physicians. Of the 17 diagnostic categories listed, there are six, maybe seven, which show marked differences. Thus, convulsive disorders represent 19.7 percent of all visits to neurologists but only 4.8 percent of visits to all physicians; multiple sclerosis, 6 percent of visits to neurologists but 1.5 percent of visits to all physicians. These neurologic disorders appear to be the ones accepted by either patient or referral sources as the "neurologist's" provenance. On the other hand, there are other neurologic disorders, trauma, disease of the muscle, disease of peripheral

TABLE 5

Distribution of Projected Patient Visits to Neurologists for Selected Categories of Neurological Diseases
(Averages for 1965, 1966, 1967, 1971)

Disease	Percent Visits to All Physicians*	Percent Visits to Neurologists*
Basal Ganglia	5.0	5.6
Cerebrovascular	11.2	8.9
Congenital Abnormalities	2.2	2.9
Convulsive Disorders	4.8	19.7
Dementia	1.9	1.8
Disease of Cranial Nerves	5.9	4.6
Dis. of Peripheral Nerves	11.1	7.5
Disease of Muscle	10.1	4.0
Disease of Spinal Cord	12.8	10.6
Infective, Parasitic Inflammatory Disease	4.9	3.8
Mental Retardation	1.0	1.1
Metabolic Disease	1.4	0.9
Multiple Sclerosis	1.5	6.0
Poisoning, drugs, other non-medicinal agents	0.3	0.3
Trauma	9.9	4.6
Tumors, Brain & CNS	1.5	4.3
Other Diseases—CNS	14.5	13.7
EEG	< 0.1	—
Average Number of Visits	65,212,000	1,139,000

* May not total 100.0 because of rounding.
Source: LEA, N.D.T.I. computer runs for Joint Commission on Neurology.

nerves and, to a lesser extent, cerebrovascular disorders, which tend to be underrepresented among visits to neurologists. In part, this may reflect a lack of consensus in medicine as to the clinical definition of and reponsibility for neurological disorders.

Table 6 lists specific neurological diseases and conditions (as opposed to general categories) which accounted, on the average, for 1 percent or more of visits to all physicians and to neurologists. (The various residual categories, such as Other Cranial Nerve Disease, are not listed.) The tendency of neurologists to receive proportionately more visits for convulsive disorders and multiple sclerosis has already been noted. In addition, this seems also true of parkinsonism, tumors of the central nervous system, trigeminal neuralgia, motor neuron disease and encephalitis. The neurologic diseases which tend to be underrepresented among visits to neurologists include cerebrovascular disease, displaced intervertebral disc, trauma to the spine and nerves, spondylitis of the spine, deafness and herpes zoster.

Those residual categories which are part of the 49 codes and which, on the average, included more than 1 percent of visits to all physicians and to neurologists are listed in Table 7. Visits to neurologists represented by diagnoses in the residual categories were 22 percent of the total visits compared with 34 percent of the total visits to all physicians. This might indicate that neurologists are usually able to make more specific neurological diagnoses than other physicians but because of the lack of any definitive data, this is speculative.

Age and the Care of Neurologic Patients

Results in Table 8 show that, on the average, patients visiting neurologists were younger than patients visiting all other physicians (40.3 percent were 39 or younger compared with 31.4 percent of patients visiting other physicians). Also, neurologists received proportionately more visits from patients under 20 (15 percent) than all other physicians (11 percent), although only 0.6 percent of visits to neurologists were by children younger than three, compared with 1.7 percent for all physicians. At least two possible explanations may be adduced: younger patients are better educated and thus more likely to seek out or to

TABLE 6

Neurological Diseases Comprising 1 Percent or More of Projected Visits to All Physicians and to Neurologists
(Averages for 1965, 1966, 1967 and 1971)

Diseases	Visits to All Physicians	Visits to Neurologists
Convulsive Disorders	4.8	19.7
Cerebrovascular Disease	11.2	8.8
Multiple Sclerosis	1.5	6.0
Parkinsonism	2.9	5.6
Displaced Intervertebral Disc	7.0	5.1
Tumors, CNS	1.5	4.3
Trauma: Head	4.9	3.2
Spine	2.8	< 1.0
Nerves	2.2	< 1.0
Cerebral Palsy	1.8	2.8
Migraine	3.1	2.8
Trigeminal Neuralgia	< 1.0	2.6
Motor Neuron Disease	< 1.0	2.3
Encephalitis	< 1.0	2.3
Dementia	1.9	1.8
Myasthenia Gravis	< 1.0	1.6
Spondylitis, spine	4.0	1.3
Athetosis	1.9	1.2
Mental Retardation	1.0	1.1
Deafness	2.4	< 1.0
Herpes Zoster	2.4	< 1.0
Metabolic Disorders	1.4	< 1.0
Torticollis	1.3	< 1.0

Source: Calculated from NDTI computer runs for Joint Commission.

TABLE 7

Residual Categories of Neurological Diseases Comprising 1 Percent or More of Projected Visits to All Physicians and to Neurologists
(Averages for 1965, 1966, 1967, 1971)

Residual Category	Visits to All Physicians	Visits to Neurologists
Other cranial nerve disease	1.8	0.6
Other peripheral nerve disease	11.0	7.1
Polymyositis and other muscle disease	9.7	2.0
Other brain disease	2.4	3.6
Other symptoms	9.0	7.3
Other diseases of the spinal cord	1.0	1.4
Total	34.9	22.0

Source: LEA, N.D.T.I. computer runs for Joint Commission on Neurology.

request a referral to a neurologist; or some of the disorders which are more likely to result in visits to a neurologist, e.g., convulsive disorders, are also more likely to appear in the young. Data for 1971 were cross-tabulated by disease and age of patient. Table 9 presents 13 diagnoses, each of which accounted for 2 percent or more of visits to neurologists or to all physicians. Even though the findings are interesting, the number of visits to neurologists in the various categories is unfortunately too small to permit any reliable conclusions. Thus, we can only speculate as to why age is related to visits to neurologists.

First Visits

NDTI classifies visits by whether or not the patient was referred. (They state that "first visit without referral" gives a count of new cases and, therefore, of incidence.) Table X presents the average percentage for the four years 1965, 1966, 1967 and 1971 of first visits without referral for diagnoses covering 2 percent or more of the total.

The fifteen diagnoses listed account for 89 percent of all first visits without referral. Three of the general residual categories, peripheral nerve disease, polymyositis and other muscle disease, and other symptoms, account for almost 50 percent of first visits without referral; 11 specific diagnoses account for 39 percent of the total. Table 10 thus offers a picture, albeit a hazy one, of what the physician can expect from the walk-in neurological patient.

TABLE 8

Distribution of Projected Patient Visits for Neurological Conditions by Age of Patients*

Patient Age	Visits to All Other Physicians				Visits to Neurologists			
	1965	1967	1971	3 Yr. Average	1965	1967	1971	3 Yr. Average
2 and Under	1.6%	1.6%	1.8%	1.7%	0.5%	0.9%	—	0.5%
3–9	3.3	2.9	3.1	3.1	3.3	7.3	2.9%	4.9
10–19	6.0	6.0	6.2	6.1	11.8	8.4	9.0	9.5
20–39	21.1	19.2	21.2	20.5	23.3	30.9	18.9	25.3
40–59	33.5	31.8	30.9	32.0	40.8	29.8	35.6	34.5
60–64	8.0	7.4	7.7	7.7	4.9	6.2	7.6	6.3
65 and Over	26.5	31.1	29.0	28.9	15.4	16.5	26.0	19.0
Total Number (Add 000)	57,317	60,105	71,625	63,016	610	959	655	741

* Age was not given for less than 2 percent of patient visits. These were excluded from distribution.

Source: LEA, N.D.T.I. computer runs for Joint Commission on Neurology.

TABLE 9

Age Distribution of Patients for Diagnoses With 2 Percent or More of Projected Visits in 1971
(Percent [1])

	Total Number (Add 000)		< 20		20–39		40–64		65+	
Diseases	All Physicians	Neurologists	All Physicians	Neurologists	All Physicians	Neurologists	All Physicians	Neurologists	All Physicians	Neurologists
Cerebrovascular Disease	8520	135	*	—	*	—	25.0	51.9	71.9	48.2
Convulsive Disorders	3684	85	33.5	45.9	27.4	40.0	27.5	12.9	11.6	—
Parkinsonism	2418	62	—	—	*	—	23.0	30.7	76.2	69.4
Multiple Sclerosis	1154	44	*	—	31.3	13.6	57.0	84.1	9.0	—
Tumors, CNS	1433	43	13.4	—	10.2	9.3	53.2	60.5	23.3	27.9
Trauma: Head	6101	19	46.5	42.1	24.0	21.1	21.7	36.8	7.8	—
Spine	2062	—	14.6	—	27.3	—	32.2	—	25.9	—
Cerebral Palsy	1197	15	15.9	—	22.0	26.7	28.3	—	34.6	73.3
Migraine	2380	14	5.9	—	46.4	35.7	42.1	64.3	5.6	—
Displaced Intervertebral Disc	6079	12	*	—	32.6	33.3	57.1	66.7	9.9	—
Spondylitis, Spine	2567	9	*	—	11.8	—	54.2	44.4	33.2	44.4
Deafness	1803	—	24.9	—	12.3	—	34.0	—	28.8	—
Herpes Zoster	1728	—	5.4	—	8.2	—	39.9	—	46.6	—

[1] May not total 100 percent because of rounding by NDTI.

* Less than 5 percent of total visits for the diagnosis; — no visits.

Source: Calculated from NDTI computer runs for Joint Commission.

TABLE 10

Diseases Representing 2 Percent or More of Projected First Visits without Referral to All Physicians. Averages for 1965, 1966, 1967, 1971

Disease	Number (000)	Percent
Total, all diseases	11,336	-100.0
Athetosis	448	4.0
Cerebrovascular disease	355	3.1
Convulsive disorders	251	2.2
Deafness	469	4.1
Other cranial nerve disease	237	2.1
Other peripheral nerve disease	1,550	13.7
Polymyositis & other muscle diseases	2,101	18.5
Spondylitis, spine	319	2.8
Torticollis	376	3.3
Displaced intervertebral disc	400	3.5
Herpes zoster	363	3.2
Trauma—Head	636	5.6
Trauma—Nerves	268	2.4
Migraine	441	3.9
Other symptoms	1,923	17.0
Total, listed diseases	10,137	89.4

Source: Calculated from NDTI computer runs for Joint Commission.

Appendix III

Commission on Professional and Hospital Activities Data

This is a report on the "actual" neurological caseload in hospitals based upon an analysis of data obtained from the Commission on Professional and Hospital Activities (CPHA). The CPHA, sponsored by the American College of Physicians, the American College of Surgeons, the American Hospital Assocation and the Southwestern Michigan Hospital Council, receives copies of discharge summaries from short-term general hospitals in the United States. In 1971, 1,284 hospitals participated in the Professional Activity Study (PAS) of the Commission. A better understanding of the "actual" hospital neurological caseload can help in the determination of both neurological manpower needs and the incidence and prevalence of neurologic disorders.

Nature of the Data

Data from the discharge summaries provided by the 1,284 participating hospitals are keypunched and stored in a computerized data bank. The Joint Commission on Neurology, in collaboration with the American Association of Neurological Surgeons, requested data from CPHA on the number of patients who were hospitalized with specific neurological conditions in 1971, the age and sex of these patients and the geographic location and size of the hospitals in which these patients were cared for. (The basic data from CPHA, too voluminous to be included in their entirety, have been summarized for this report.)

The diagnostic data in the CPHA data file are coded according to the H–ICDA, 1968 classification. The request to CPHA specified 567 separate code numbers (diseases), of which 57 were neurosurgical procedures. The balance, a total of 510 diagnoses, have been combined into 46 specific and residual disease categories and into 17 broader categories to simplify the presentation of the data (Table 1).

It should be kept in mind that the participating CPHA hospitals are not representative of all American Hospital Association accredited hospitals (Table 2). For example, while 18 percent of all hospitals and 17 percent of all hospital beds are included in the CPHA files, this includes one-third of all 200–399 bed hospitals and one-fourth of 100–199 bed hospitals. However, relatively few of either the smallest or largest hospitals are included in the CPHA file. In addition, the North Central census region is overrepresented and the South underrepresented. Because of these differences between the CPHA hospitals and all accredited hospitals, the sample of patients for which data are available cannot be viewed as representative of all hospitalized patients.

In 1971, 1,284 CPHA hospitals provided data on 10,207,191 patients. Of these, 830,344 (8.1 percent of the total) were patients with a primary neurological diagnosis and 1,332,317 (13.1 percent of the total) were patients with primary and/or secondary neurological diagnoses. (It should be noted that the data provided by CPHA in their print-out did not permit the statistical separation of patients with only a secondary diagnosis of neurological disease from the total group.)

The analysis of the data from CPHA deals with two major issues: the correlates of hospitalization for neurological disorders and the demographic correlates of neurological disorders among CPHA patients.

Correlates of Hospitalization

Table 3 presents the geographical distribution of all CPHA patients and patients with neurological diagnoses, as well as of CPHA and AHA hospitals and beds. The problem of sample representativeness indicated by Table 2 seems even more marked here; all CPHA hospital beds are distributed so that the North Central region, with 28 percent of both the popula-

TABLE 1

Classification of Specific Neurological Diseases

- Basal Ganglia Diseases
  - Parkinsonism
  - Huntington's Chorea
  - Wilson's Disease
  - Dystonia M. Deformans
  - Athetosis
- Dyskinesia
- Cerebrovascular Disease
- Congenital Abnormalities
  - Cerebral Palsy
  - Other Abnormalities CNS
- Convulsive Disorders
- Dementia
- Diseases of Cranial Nerves
  - Bell's Palsy
  - Deafness
  - Trigeminal Neuralgia
  - Other Cranial Nerve Disease
- Diseases of Peripheral Nerves
  - Charcot-Marie-Tooth
  - Guillain-Barre Syndrome
  - Other Diseases of Peripheral Nerves
- Diseases of Muscle
  - Myasthenia Gravis
  - Muscular Dystrophy
  - Polymyositis & Other Diseases of Muscle
- Diseases of Spinal Cord
  - Dorsolateral Sclerosis
  - Motor Neuron Disease
  - Syringomyelia
  - Other Diseases, Spinal Cord
  - Spondylitis, Spine
  - Torticollis
  - Displaced Intervertebral Disc
- Infectious, Parasitic, Inflammatory Diseases
  - Encephalitis
  - Herpes Zoster
  - Meningitis
  - Poliomyelitis
  - Syphilis
  - Other Diseases
- Mental Retardation
- Metabolic Disorders
- Multiple Sclerosis
- Poisoning: Drugs, Non-medicinal Agents
- Trauma
  - Head
  - Spine
  - Nerves
  - Birth Injuries
- Other Diseases, CNS
  - Migraine
  - Other Diseases of Brain
  - Other Symptoms

TABLE 2

CPHA Hospitals and Hospital Beds as Percent of All AHA Hospitals* and Hospital Beds in U.S., 1971, by Census Region

Hospital Size (Beds)	Northeast		North Central		South		West		All United States	
	Hospitals	Beds	Hospitals	Beds	Hospitals	Beds	Hospitals	Beds	Hospitals	Beds
1–99	13	15	15	17	7	8	11	13	11	13
100–199	19	20	37	38	20	21	22	22	25	25
200–399	34	35	45	45	[illegible]	21	32	32	34	34
400 +	16	8	25	16	11	7	12	8	17	10
All Hospital Sizes	21	15	26	25	12	12	16	23	18	17
AHA Totals	1,274	444,752	1,997	427,180	2,437	467,869	1,353	209,864	7,061	1,549,665

* General, short-stay hospitals only.
Source: CPHA, Ann Arbor, Michigan; AHA.

tion and AHA hospital beds, has 41 percent of CPHA beds while the South, with 31 percent of the population and 30 percent of AHA beds, has 20 percent of the CPHA hospital beds, And the distribution of all CPHA patients among the census regions, as well as those with neurological diagnoses, not unexpectedly, follows the distribution of hospital beds.

The same basic data are viewed somewhat differently in Table 4, which presents the proportion of total CPHA patients in each of the four census regions having a primary neurological diagnosis and having a primary and/or secondary neurological diagnosis. In this comparison, the West stands out, showing the greatest percentage of patients with neurological disease. This difference is probably explained by the very strong positive correlation between age and hospitalization for neurological problems (Tables 6 and 7) and the higher proportion of elderly among all hospitalized patients in the West (Table 6).

Table 5 shows how all patients are distributed among different-size hospitals in the four census regions. Except for the South, where patients are evenly divided among the three sizes of hospitals, there tends to be a relative concentration of patients in the 200–399 bed hospitals in the other three regions as well as nationally, with 41.5 percent of all CPHA patients hospitalized in the 200–399 bed hospitals in 1971. (The same pattern is observed with respect to neurological patients.)

Table 6 shows the distribution by age of all CPHA patients; Table 7 shows the same distribution for all CPHA patients with primary and/or secondary neurological diagnoses; and Table 8 gives the same data for CPHA patients with primary neurological diagnoses. An examination of the data in these three tables reveals that the median age of all CPHA patients in 1971 was 34.1 years compared to a median age of 52.4 for patients with any neurological diagnosis and a median age of 47.8 years for patients with a primary diagnosis of neurological disease. The difference between neurological and other patients appears reasonable given that most neurological disease requiring hospitalization affects older people rather than younger ones. (See Table 8). The finding

TABLE 3

Percentage Distribution of Neurological Patients, All Patients, Beds and Hospitals in CPHA Data Bank, All AHA Beds and Hospitals* and U.S. Population (1970), by Census Region, 1971

	Northeast	North Central	South	West	All United States (Number)
Patients with Primary Neurological Diagnosis	22.9	39.7	20.2	17.2	830,344
Patients with Primary and/or Secondary Neurological Diagnosis	23.1	40.0	20.4	16.4	1,332,317
All Patients in CPHA Hospitals	24.0	40.1	21.6	14.2	10,207,191
CPHA: Hospitals	20.6	39.8	22.9	16.7	1,284
Beds	25.5	40.6	20.2	13.7	265,396
All AHA Hospitals	18.0	28.3	34.5	19.2	7,061
Beds	28.7	27.6	30.2	13.5	1,549,665
U.S. Population (1970)	24.1	27.8	30.9	17.1	203,212,000**

* General, short-stay hospitals only.

** Excludes Puerto Rico.

Sources: CPHA, Ann Arbor, Michigan; AHA; U.S. Census Bureau.

TABLE 4

Percentage Distribution of Neurological Patients in CPHA Hospitals by Census Region, 1971

Patients	Northeast	North Central	South	West
Patients with Primary Neurological Diagnoses	7.8	8.0	7.6	9.8
Patients with Primary and/or Secondary Neurological Diagnoses	12.6	13.0	12.3	15.1
N (All Patients in CPHA Hospitals)	(2,450,172)	(4,096,441)	(2,206,832)	(1,453,746)

Source: CPHA, Ann Arbor, Michigan

that these patients with a primary and/or secondary neurological diagnosis have the highest median age may reflect the fact that multiple problems are concentrated in this group, this concentration reflecting in turn the general physical deterioration of old age.

A second point which should be noted concerns the relation between age and census region. By and large, there appear to be a few age differences associated with region among *all* CPHA patients; however, those in the West show the oldest median age, 35.5 years, a finding which makes sense given the larger percentage of neurological patients in that region. At the same time, the median age of the neurological patients themselves is lowest in the West. We can only speculate as to the reason for this. It might be related to the distribution of types of neurological disease by region: cerebrovascular disease, pre-eminently an affliction of extreme old age, is proportionately less frequent in the West while diseases of the spinal cord, which tend to occur somewhat earlier, are proportionately more common in the West (Tables 11 and 13).

Table 9 compares all CPHA patients and those with primary and/or secondary neurological diagnoses by age and sex. In all age categories, from birth to 60 years of age, neurological patients are more likely to be male than are CPHA patients in general. (Of course, pregnancies and deliveries are present in the data on "all" patients and are largely responsible for the greater differences observed during the childbearing ages, but still men appear somewhat more vulnerable to neurological diseases necessitating hospitalization than they are to other diseases.) This sex difference disappears after age 60 and is reversed after age 70, probably reflecting the greater longevity of women. Put another way, CPHA

TABLE 5

Percentage Distribution of All Patients Hospitalized in CPHA Hospitals, 1971, by Size of Hospital and Census Region

Hospital Size (beds)	All United States Number	All United States Percent	Northeast Percent	North Central Percent	South Percent	West Percent
1–199	2,729,235	26.7	16.4	26.5	33.0	35.4
200–399	4,234,467	41.5	50.4	38.4	33.3	47.5
400 +	3,243,489	31.8	33.2	35.1	33.7	17.1
All Sizes	10,270,191	100.0	2,450,172	4,096,441	2,206,832	1,453,746
Percent	100.0		24.0	40.1	21.6	14.2

Source: CPHA, Ann Arbor, Michigan.

TABLE 6

Percentage Distribution by Age and Sex of All Patients Hospitalized in CPHA Hospitals During 1971, by Census Region

Ages	Northeast	North Central	South	West	All United States
< 1	12.0	12.1	12.4	11.1	12.0
1–9	7.7	7.4	6.5	6.0	7.1
10–19	8.8	9.4	9.6	9.5	9.3
20–29	17.1	17.3	17.6	17.7	17.4
30–39	10.0	10.2	10.7	10.3	10.3
40–49	10.4	10.6	10.8	10.7	10.6
50–59	11.0	10.7	10.5	11.2	10.8
60–69	10.2	9.7	10.0	10.3	10.0
70 +	12.9	12.5	11.7	13.2	12.5
All Ages	2,450,172	4,096,441	2,206,832	1,453,746	10,207,191
Median Age	34.5	33.6	33.5	35.5	34.1

Source: CPHA, Ann Arbor, Michigan.

TABLE 7

Percentage Distribution by Age of All Patients with Primary and/or Secondary Neurological Diagnoses Hospitalized in CPHA Hospitals During 1971, by Census Region

Ages	North-east	North Central	South	West	All United States
< 1	2.5	2.0	2.3	1.9	2.2
1–9	6.5	5.0	4.6	4.2	5.1
10–19	7.4	7.0	6.3	7.2	7.0
20–29	9.1	9.6	9.4	11.0	9.7
30–39	8.5	9.9	10.4	10.8	9.8
40–49	11.6	12.8	13.5	13.5	12.8
50–59	13.7	14.1	14.2	14.4	14.1
60–69	14.7	14.3	14.9	13.9	14.4
70+	25.9	25.4	24.4	23.2	24.9
All Ages	307,668	533,402	272,121	219,126	1,332,317
Median Age	53.1	52.7	52.5	51.0	52.4

Source: CPHA, Ann Arbor, Michigan.

TABLE 8

Percentage Distribution by Age of Patients in CPHA Hospitals During 1971, with Specific Primary Neurological Diagnoses by Census Region

Ages	North-east	North Central	South	West	All United States
< 1	1.4	1.1	1.4	1.1	1.3
1–9	7.8	5.8	5.2	4.6	5.9
10–19	9.2	8.5	7.4	8.2	8.4
20–29	10.7	11.0	11.0	12.4	11.2
30–39	10.3	11.8	12.6	12.7	11.8
40–49	13.3	14.5	15.4	15.3	14.6
50–59	13.9	14.2	14.5	14.9	14.3
60–69	13.0	12.8	13.3	12.5	12.9
70+	20.2	20.1	19.3	18.2	19.6
All Ages	190,470	329,425	167,981	142,468	830,344
Median Age	47.8	48.0	48.1	47.1	47.8

Source: CPHA, Ann Arbor, Michigan.

patients with a neurological diagnosis are distributed like the total U.S. population in terms of sex, 48.7 percent male for neurological patients, 48.5 percent male for the population as a whole, while only 40.3 percent of CPHA patients as a whole are male.

Table 10 describes the four census regions in terms of the use of selected diagnostic procedures in CPHA hospitals. A comparison of the degree to which the distribution of neurological procedures deviates from the distribution of all neurological patients indicates some regional variations in the use of such procedures. Thus, EEG's are somewhat overrepresented in the West while echoencephalography is markedly overrepresented in the Northeast and underrepresented in the North Central area and in the West. Arteriography appears evenly distributed while myelography is overrepresented in the West. Spinal punctures are overrepresented in the Northeast and underrepresented in the North Central states while radioisotope scans are somewhat underrepresented in the West. A determination of the factors responsible for these variations—differential availability of hardware and technicians, differences in the incidence of symptomology and diseases, and different styles of practice—requires data which are not available to us.

Demographic Correlates of Neurological Diagnoses

Table 11 shows, for those patients with a primary neurological diagnoses, the distribution by region of the 17 broad categories of neurological disease. There are a number of differences among the regions, e.g., with respect to cerebrovascular disease, diseases of the spinal cord. etc., but in all census regions, the major diagnostic categories are Disease of the Spinal Cord, Trauma, Cerebrovascular Disease and the residual Other Diseases—CNS. These four categories encompass about 75 percent of the primary neurological diagnoses in each region, ranging from 74.3 percent in the West to 76.7 percent in the North Central.

TABLE 9

Percentage Distribution by Sex and Age of All Patients and Patients with Primary and/or Secondary Neurological Diagnoses Hospitalized in CPHA Hospitals During 1971

Age	Percent Male: All Patients	Percent Male: Neurological Patients	Discrepancy
< 1	52.5	57.5	+ 5.0
1–9	56.7	58.6	+ 1.9
10–19	37.8	56.8	+19.0
20–29	20.1	49.3	+29.2
30–39	30.5	49.1	+18.6
40–49	39.8	47.9	+ 8.1
50–59	47.6	50.4	+ 2.8
60–69	50.6	50.4	− 0.2
70+	43.3	40.9	− 2.4
All Ages	40.3	48.5	+ 8.2

% Male in U.S. 48.7.

Table 12 shows the proportion of neurological patients who are male among patients with a primary neurological diagnosis and among all neurological patients ("Total"). There are, as one would expect, major variations in the sex distribution of the various neurological diseases, ranging from multiple sclerosis, where 27.5 percent of the patients with a primary and 28.8 percent of the patients with a primary and/or secondary neurological diagnosis are male, to nerve trauma where the percentages male are 70.3 and 71.7 respectively. There are also some sex-related variations between the proportion of males with the primary diagnoses and the proportion of males with the "total" diagnoses, the most dramatic of which is in the category for poisoning (#14 in Table 12).

Finally, Table 13 gives the distribution of patients with specific primary diagnoses by age. The variations are indeed great, but no attempt to interpret them will be made here. Both this and the preceding table are presented so that the data included in them will be available. Of course, these distributions should be interpreted with caution—they represent only hospitalized patients in a very large but somewhat unrepresentative sample of short term general hospitals.

TABLE 10

Percentage[1] Distribution of Selected Diagnostic Procedures Performed on In-Patients in CPHA Hospitals During 1971, by Census Region

Procedure	Northeast	North Central	South	West	All United States (Number)
EEG	21.2	39.3	17.8	21.8	9,177
Echoencephalography	36.0	30.1	21.0	12.9	11,949
Arteriography, head & neck	20.9	40.0	20.1	18.9	33,663
Myelography	20.2	37.2	18.0	24.6	43,705
Spinal puncture	30.7	33.5	20.6	15.1	103,876
Radioisotope scan	27.7	40.4	19.2	12.7	182,261
Patients Hospitalized for Primary and/or Secondary Neurological Diagnoses	23.1	40.0	20.4	16.4	1,332,317

[1] Percentages may not total 100.0 because of rounding.
Source: CPHA, Ann Arbor, Michigan.

TABLE 11

Percentage Distribution of Categories of Neurological Disease: Primary Diagnoses of Patients in CPHA Hospitals During 1971, by Census Region

Categories	North-east	North Central	South	West	All United States
Basal Ganglia Diseases	1.3	1.6	1.4	1.2	1.4
Cerebrovascular Disease	21.3	20.9	21.4	17.5	20.5
Congenital Abnormalities	0.9	0.8	0.9	0.8	0.8
Convulsive Disorders	6.1	5.1	5.2	4.5	5.2
Dementia	0.2	0.2	0.3	0.4	0.3
Diseases of Cranial Nerves	1.4	1.6	1.6	1.7	1.6
Diseases of Peripheral Nerves	2.9	3.0	3.3	3.8	3.2
Diseases of Muscle	0.4	0.4	0.4	0.3	0.4
Diseases of Spinal Cord	20.5	23.6	22.2	25.5	22.9
Infective, Parasitic, Inflammatory Diseases	3.0	2.8	3.4	2.9	3.0
Mental Retardation	0.2	0.2	0.2	0.3	0.2
Metabolic Disorders	0.7	0.9	1.0	1.0	0.9
Multiple Sclerosis	0.8	0.8	0.4	0.7	0.7
Poisoning, Drugs, Other Non-Medicinal Agents	5.1	3.8	3.6	5.4	4.4
Trauma	23.8	20.7	20.3	21.0	21.4
Tumors, Brain and Other CNS	2.4	2.0	2.1	2.6	2.2
Other Diseases—CNS	9.1	11.5	12.2	10.3	10.9
All Categories	190,470	329,425	167,981	142,468	830,344
Percent	22.9	39.7	20.2	17.2	100.0

Source: CPHA, Ann Arbor, Michigan.

TABLE 12

Percentage Distribution by Sex of Patients with Primary and/or Total Neurological Diagnoses, CPHA Hospitals, 1971

	Primary		Total	
	Percent Male	Number	Percent Male	Number
1. Basal Ganglia Diseases	45.9	11,810	46.4	35,920
a) Parkinsonism	46.1	7,547	47.5	24,552
b) Huntington's Chorea	39.0	213	35.3	394
c) Wilson's Disease	51.6	64	54.4	149
d) Dystonia M. Deformans	44.9	107	41.6	185
e) Athetosis	46.5	3,196	44.8	8,423
f) Dyskinesia	42.9	683	45.0	2,217
2. Cerebrovascular Disease	47.8	170,355	46.9	338,956
3. Congenital Abnormalities	53.4	6,846	51.9	18,124
a) Cerebral Palsy	55.0	2,622	53.9	7,016
b) Other Abnormalities CNS	52.4	4,224	50.7	11,108
4. Convulsive Disorders	53.1	43,529	51.0	90,167
5. Dementia	40.8	2,157	38.3	6,955
6. Diseases of Cranial Nerves	39.0	12,971	40.7	27,472
a) Bell's Palsy	42.1	2,241	43.2	4,999
b) Deafness	47.6	668	48.6	4,410
c) Trigeminal Neuralgia	33.3	2,701	33.2	3,949
d) Other Cranial Nerve Disease	39.3	7,361	39.5	14,114

TABLE 12

Percentage Distribution by Sex of Patients with Primary and/or Total Neurological Diagnoses, CPHA Hospitals, 1971—Con.

	Primary		Total	
	Percent Male	Number	Percent Male	Number
7. Diseases of Peripheral Nerves	38.6	26,267	42.5	46,565
a) Charcot-Marie-Tooth	62.4	197	60.2	407
b) Guillain-Barre Syndrome	51.7	1,743	50.3	3,000
c) Other Disease of Peripheral Nerves	37.5	24,327	41.7	43,158
8. Diseases of Muscle	46.4	2,963	47.7	7,647
a) Myasthenia Gravis	36.2	951	32.8	1,836
b) Muscular Dystrophy	69.4	582	63.9	1,458
c) Polymyositis & Other Diseases of Muscle	43.7	1,430	48.5	4,353
9. Diseases of Spinal Cord	50.0	190,267	46.5	333,599
a) Dorsolateral Sclerosis	35.8	3,080	35.2	8,863
b) Motor Neuron Disease	53.9	1,710	54.6	2,772
c) Syringomyelia	54.3	140	53.4	281
d) Other Diseases, Spinal Cord	44.6	42,624	43.1	78,698
e) Spondylitis, Spine	42.5	23,550	40.7	82,080
b) Torticollis	41.1	17,987	42.8	29,783
g) Displaced Intervertebral Disc	56.1	101,176	53.6	131,122
10. Infections, Parasitic, Inflammatory Diseases	49.1	25,399	48.9	45,867
a) Encephalitis	49.1	5,636	48.4	9,780
b) Herpes Zoster	33.5	4,216	35.4	7,727
c) Meningitis	53.4	13,940	53.4	22,378
d) Poliomyelitis	45.6	511	46.5	3,440
e) Syphilis	52.9	350	56.4	1,193
f) Other Diseases	56.8	746	53.5	1,349
11. Mental Retardation	49.1	1,768	48.8	11,088
12. Metabolic Disorders	38.4	7,392	40.5	18,639
13. Multiple Sclerosis	27.5	5,843	28.8	9,886
14. Poisoning: Drugs, Non-medicinal Agents	33.4	36,123	44.3	63,090
15. Trauma	59.3	177,504	59.4	287,206
a) Head	65.2	99,270	65.5	155,702
b) Spine	51.1	74,641	49.4	110,655
c) Nerves	70.3	3,335	71.7	10,524
d) Birth Injuries	65.1	258	61.7	10,325
16. Tumors: Brain & Other CNS	47.7	18,602	50.6	31,963
17. Other Diseases, CNS	43.2	90,427	45.0	259,706
a) Migraine	29.3	9,489	26.8	16,290
b) Other Diseases of Brain	52.5	6,986	52.6	25,354
c) Other Symptoms	44.1	73,952	45.5	218,062
Total	49.6	830,344	48.6	1,634,741*

* This total represents diagnoses; some patients had more than a single neurological diagnosis, so this total is greater than the 1,332,317 patients with a primary and/or secondary neurological diagnosis.

Source: CPHA, Ann Arbor, Michigan.

TABLE 13

Percentage Distribution by Age of Patients with Specific Primary Neurological Diagnoses in CPHA Hospitals, 1971

	< 1	1–9	10–19	20–39	40–59	60+	Total Number
1. Basal Ganglia Diseases	*	1.9	3.5	12.1	21.7	60.5	11,810
a) Parkinsonism	0	*	*	*	15.5	83.5	7,547
b) Huntington's Chorea	0	1.9	5.6	13.6	49.8	29.1	213
c) Wilson's Disease	0	3.1	21.9	40.7	15.7	18.8	64
d) Dystonia M. Deformans	0	5.6	21.5	30.0	28.0	14.9	107
f) Athetosis	1.4	3.1	9.0	37.4	33.3	15.8	3,196
g) Dyskinesia	1.9	15.7	7.8	12.7	27.3	34.5	683
2. Cerebrovascular Disease	*	*	*	1.5	16.6	80.2	170,355
3. Congenital Abnormalities	17.9	31.8	19.2	16.9	10.1	4.0	6,846
a) Cerebral Palsy	2.3	43.9	29.0	12.4	8.3	3.8	2,622
b) Other Abnormalities CNS	27.7	24.2	13.1	19.6	11.2	4.2	4,224
4. Convulsive Disorders	5.5	23.9	14.8	22.8	21.0	12.2	43,529
5. Dementia	0	*	*	*	11.8	87.7	2,157
6. Diseases of Cranial Nerves	*	2.8	4.3	18.6	36.4	37.7	12,971
a) Bell's Palsy	*	3.4	8.0	22.9	34.1	31.3	2,241
b) Deafness	*	17.1	10.2	19.3	35.0	17.9	668
c) Trigeminal Neuralgia	0	*	*	8.4	30.7	60.1	2,701
d) Other Cranial Nerve Disease	*	2.3	3.9	20.9	39.3	33.3	7,361
7. Diseases of Peripheral Nerves	*	*	4.0	26.7	47.7	20.7	26,267
a) Charcot-Marie-Tooth	0	8.1	32.5	25.9	21.9	11.7	197
b) Guillain-Barre Syndrome	*	5.2	11.9	22.7	36.1	24.0	1,743
c) Other Disease of Peripheral Nerves	*	*	3.2	27.1	48.8	20.6	24,321
8. Diseases of Muscle	2.0	7.7	9.2	21.8	31.6	27.6	2,963
a) Myasthenia Gravis	*	1.1	6.3	23.1	29.1	40.2	951
b) Muscular Dystrophy	*	17.0	18.2	25.0	28.2	11.0	582
c) Polymyositis & Other Diseases of Muscle	4.1	8.4	7.4	19.6	34.6	26.0	1,430
9. Diseases of Spinal Cord	*	*	2.6	31.3	46.4	19.4	190,267
a) Dorsolateral Sclerosis	0	*	*	4.3	18.0	77.4	3,080
b) Motor Neuron Disease	*	1.4	1.8	9.2	38.8	48.6	1,710
c) Syringomyelia	0	0	7.1	34.3	46.4	12.2	140
d) Other Diseases, Spinal Cord	*	*	2.9	32.8	45.1	18.9	42,624
e) Spondylitis, Spine	*	*	*	6.1	43.5	50.2	23,550
f) Torticollis	*	2.0	12.9	46.0	31.4	7.6	17,987
g) Displaced Interveterbral Disc	*	*	1.3	35.2	51.3	12.2	101,176
10. Infections, Parasitic, Inflammatory Diseases	9.0	20.6	13.3	18.2	16.8	22.1	25,409
a) Encephalitis	3.5	26.0	19.4	26.7	15.3	8.9	5,636
b) Herpes Zoster	*	1.4	1.6	3.6	18.5	74.8	4,226
c) Meningitis	14.6	25.6	13.9	18.8	15.8	11.3	13,940
d) Poliomyelitis	*	5.3	32.7	29.6	22.3	9.6	511
e) Syphilis	2.0	1.7	1.2	7.2	27.4	60.5	350
f) Other Diseases	4.3	14.3	13.3	24.1	27.7	16.4	746
11. Mental Retardation	3.2	20.3	32.0	32.3	9.5	2.7	1,768
12. Metabolic Disorders	1.8	7.1	8.9	32.2	32.3	17.6	7,393
13. Multiple Sclerosis	*	*	1.8	41.7	47.1	9.3	5,843
14. Poisoning: Drugs, Non-medicinal Agents	*	9.5	17.0	37.4	25.0	10.8	36,123
15. Trauma:	1.4	11.9	18.6	30.5	21.8	16.0	177,504
a) Head	2.4	20.6	26.6	26.3	14.0	10.1	99,270
b) Spine	*	*	7.8	35.1	32.1	24.5	74,641
c) Nerves	*	5.6	20.8	43.0	23.9	6.7	3,335
d) Birth Injuries	71.3	14.3	9.7	3.5	*	0	258
16. Tumors: Brain & Other CNS	*	4.9	6.6	16.9	39.2	31.9	18,602

TABLE 13

Percentage Distribution by Age of Patients with Specific Primary Neurological Diagnosis in CPHA Hospitals, 1971—Con.

	< 1	1–9	10–19	20–39	40–59	60+	Total Number
17. Other Diseases, CNS	1.1	3.7	9.7	27.0	30.8	27.7	90,427
a) Migraine	*	2.0	10.3	43.7	37.2	6.8	9,489
b) Other Diseases of Brain	4.0	7.4	5.0	12.3	27.7	43.7	6,986
c) Other Symptoms	*	3.5	10.1	26.3	30.3	29.0	73,952
Total	1.3	5.9	8.4	23.0	28.9	32.5	830,344

0 = No cases.
* = < 1 percent.
Source: CPHA, Ann Arbor, Michigan.

Appendix IV

Source of Referral Presenting Complaint and Diagnoses in Neurological Practice

This is a report on a study designed to improve our picture of current neurological practice in terms of: 1) the frequency of different presenting complaints brought to neurologists; 2) the types of patients, in terms of final diagnosis, seen by neurologists; and 3) the referral sources of patients seen by neurologists.

Methodology

Each member of the Task Force on Patient Care, as well as neurologists with whom they worked, were asked to record the referral source, presenting complaint and diagnosis of each patient seen for a period of four consecutive weeks. The neurologists participating in the study represented different practice settings (solo private practice, both large and small multispecialty private group practices, a prepaid multispecialty group practice, and a university medical center) and varied geographic areas in the United States.

Even though the sample represented 30 neurologists from 13 geographic locations and seven practice settings, this particular "sample" of neurologists was used because of direct or indirect involvement with the Joint Commission on Neurology and cannot be considered a representative one. Additionally, a variety of factors which may affect the source and nature of the patient caseload—rural versus urban location, the size of the general population, the number of physicians, neurosurgeons and neurologists servicing the population, and the degree of sophistication characterizing the referring physicians in these areas—are not taken into account in the analysis. In short, this survey only deals with the particular neurological conditions which came to this particular group of neurologists and will tell us nothing about those who remain untreated or who are dealt with by other physicians. Finally, it should be noted that the actual data collection procedures were not standardized but reflected the style and judgment of each of the participating neurologists; offsetting this, however, was the concrete nature of the information sought (source of referral, complaint, diagnosis) which probably tended to provide a structure of its own.

The data, which involved 2,964 patients (of whom 3 percent were seen for follow-up visits), 52 symptoms (presenting complaints), 36 diagnoses and 27 referral sources, were put onto IBM cards to permit a statistical analysis.

Results

The data on presenting complaints will be examined first, the data on final diagnoses second, and the data on sources of referral last.

Presenting Complaints

The 52 presenting complaints included in the data were grouped into seven major categories to permit statistical analysis. The distribution of patients in these complaint categories are given in Table 1. Two categories, those involving pain and those involving higher cerebral functions, account for almost one-half (49 percent) of all presenting complaints. Childhood disorders account for the smallest proportion of all complaints, only 3.1 percent of the total.

Of the 52 specific complaints included within these seven categories, only 14 accounted for 2 percent or more of the total number of complaints presented by the patients (Table 2). However, these 14 comprise approximately 70 percent of all complaints, two of them, spells (i.e., seizures, epilepsy, blackouts, syncope, amnesia, fugues, feelings of horror and fainting, etc.) and head and facial pain (i.e., vascular and non-vascular headaches, and eye, ear or face pain), accounting for 16.5 and 13.5 percent of all complaints respectively. Also worth noting is the fact that only

TABLE 1

Distribution of the Seven Complaint Categories

Complaints Involving:	Number of Patients	Percent of Sample Total
Pain (in any area of body)	738	24.9
Higher Cerebral Functions: spells, dementia, aphasia, personality changes, etc.	724	24.4
Weakness: Bell's Palsy, loss of voice, double vision, weakness of the extremities, and muscle disease such as muscular dystrophy, etc.	384	13.0
Movement & Motility Symptoms: falling, spasticity, multiple sclerosis, etc.	363	12.2
Sensory Symptoms: numb face, auditory-visual disturbance, neuritis, etc.	314	10.6
Childhood Disorders: mental retardation, behavior disorders, cerebral palsy, developmental delay, genetic anomalies, etc.	91	3.1
All Other Complaints: pernicious anemia, nerve conduction studies, disability evaluation, neoplasm, trauma, etc.	350	11.8
Total	2,964	100.0

3.4 percent of all patients were being seen for follow-up by the neurologists in the sample. Given the chronic nature of so many neurologic diseases, the fact that follow-ups (a rough indicator of the extent to which a physician has primary responsibility for the patient's care) comprise such a small proportion of the patients is surprising. Of course, this may be due in part to the special nature of some of the facilities represented, e.g., a university medical center and the Mayo Clinic.

Diagnosis

The 2,964 patients in the sample were given a total of 36 diagnoses by the participating neurologists. Table 3 lists those 15 diagnoses given to 2 percent or more of the sample. These 15 diagnoses account for over two-thirds of all the patients, while the eight most frequent diagnoses account for half of all patients. The two most frequent diagnoses are general epilepsies (12 percent) and focal cerebrovascular disease (8 percent). Finally, only 3.4 percent of the patients were diagnosed as not having a neurologic disorder. The fact that so few patients are inappropriately referred strongly suggests that the special competence of the neurologist is both known to and accepted by those involved in screening and referring of patients. It also suggests that those involved in screening and referring are serving those functions well.

TABLE 2

Distribution of Major* Specific Presenting Complaints

Presenting Complaints	Number of Patients	Percent of Total Sample
Spells (fits & faints)	489	16.5
Pain—head & face	401	13.5
Pain—back & lower extremities	173	5.8
Pain—neck & upper extremities	120	4.1
Weakness, nonspecific	107	3.6
Follow-up	100	3.4
Involuntary Movement	98	3.3
Altered Consciousness	97	3.3
Vestibular Symptom	87	2.9
Impaired Movement	83	2.8
Hemiparesis	81	2.7
Trauma	67	2.3
Gait Disturbance	61	2.1
Lower Extremity Weakness	60	2.0
All Other Complaints	940	31.7
Total	2,964	100.0

* Two percent or more of the total number of complaints.

TABLE 3

Distribution of Major Diagnostic Categories

Major Diagnostic Categories (more than 2 Percent)	Number of Patients	Percent of Total Sample
General Epilepsies	357	12.0
Focal Cerebral Vascular Disease	236	8.0
Multiple Sclerosis	174	5.9
Parkinsonism	170	5.7
Migraine (vascular) Headache	163	5.5
Psychiatric Disorder	143	4.8
Herniated Nucleus Pulposus & Compressive Radiculopathies and Myelopathies	137	4.6
Other Bone & Joint	118	4.0
No Neurological Disease	102	3.4
Intracranial Tumor	85	2.9
Cranial Neuropathy	82	2.6
Polyneuropathy	80	2.7
CNS Trauma	78	2.6
Spinal Neuropathies	72	2.4
Partial Epilepsies	71	2.4
All Other Diagnoses	896	30.2
Total	2,964	100.0

TABLE 4

The Relation of Presenting Complaints to Final Diagnoses

SPELLS	*Percent*
General Epilepsy	60.0
Partial Epilepsy	12.0
All Other Diagnoses	28.0
Total: 489	
PAIN—Back, Lower Extremities	*Percent*
Herniated Nucleus Pulposus	39.9
Other Bone & Joint Disorders	28.3
No Neurologic Disease	6.9
All Other Diagnoses	24.9
Total: 173	
WEAKNESS, Not Elsewhere Classified	*Percent*
Heredofamilial	12.2
Motor Neuron Disease	10.3
Psychiatric Disorders	8.4
Polyneuropathies	6.5
Other Bone & Joint Disorders	6.5
All Other Diagnoses	56.1
Total: 107	
ALTERED CONSCIOUSNESS	*Percent*
Symptoms: Coma & Stupor	32.0
Focal CVD	22.7
CNS Trauma	7.2
All Other Diagnoses	38.1
Total: 97	
PAIN—Head & Face	*Percent*
Migraine (vascular) Headache	36.0
Headache, non-Vascular	29.0
Psychiatric Disorder	6.5
All Other Diagnoses	28.5
Total: 401	
PAIN—Neck, Upper Extremities	*Percent*
Herniated Nucleus Pulposus	30.8
Other Bone & Joint Disorders	28.3
No Neurologic Disease	9.2
All Other Diagnoses	31.7
Total: 120	
INVOLUNTARY MOVEMENTS	*Percent*
Parkinsonism	49.0
Other Movement Disorder	20.4
Psychiatric Disorders	6.0
Heredofamilal	6.0
All Other Diagnoses	18.6
Total: 98	

Thus far, presenting complaints and final diagnoses have been dealt with separately. Table 4 presents some of the data on their relationship. Those seven categories of presenting complaints which include 90 or more patients are listed along with the final diagnoses most often given the patients in that category. (An eighth category, follow-up, while containing more than 90 patients, is not included in this analysis). The seven complaint categories represent one-half (50.1 percent) of the total sample. By and large, partcular complaints seem to be tied to particular diagnoses in that one-half to three-quarters of the patients in a particular complaint category tend to be given one of two diagnoses. The major exception is the category of weakness, where the two most common diagnoses account for only 22.5 percent of the patients with that symptom.

Source of Referral

In order to permit statistical analysis, the 27 different sources of referral for the patients in this sample were grouped into the 12 major categories listed in Table 5. As one would expect, given that neurology is not a primary care specialty, most referrals are from other physicians, almost four out of five patients having been referred by an internist (29 percent), a general practitioner (23 percent), or another physician. An additional eleven percent were referred by other components of the health care system. In other words, ninety percent of the patients seen in this sample had been screened by someone else in the health care system and then referred to a neurologist. The fact that internists are the largest source of referral should not be considered surprising. Aside from being the largest specialty group, internists provide a great deal of primary care, often serving as the equivalent of general or family practitioners. Because information on how many neurologic patients are referred to an internist first would give us a better idea of the efficiency with which screening for neurologic diseases is carried out, it is unfortunate that the data does not permit us to determine this. Finally, the small percentage of referrals from neurosurgery (2.2 percent) may be interpreted as supporting the widely held opinion that often neurosurgeons also practice neurology in many situations, or as reflecting the relatively small number of neurosurgeons in relation to other medical specialties.

Viewing the data somewhat differently (Table 6), we can see that 11.3 percent of the referrals were probably from a non-medical source and 22.2 percent probably from non-physician sources, and that for at

TABLE 5

Distribution of Referral Sources

Referral Source	Number	Percent
Internal Medicine	868	29.0
General Practice	693	23.0
Health Facilities (out-patient clinics, emergency rooms, voluntary health agencies, etc.)	326	11.0
Neurology	257	8.7
Self	174	5.9
Surgical Specialties (general, orthopedic, plastic and vascular surgery)	126	4.3
Pediatrics	126	4.3
All Other Medical Specialties	117	4.0
Other Agencies (state and municipal agencies, workmen's compensation, etc.)	107	3.6
Neurosurgery	66	2.2
Psychiatry	52	1.8
"Unclassifiable" (illegible or not given, etc.)	52	1.8
Total	2,964	(100)

TABLE 6

Lay and General Practitioner as Source of Referral

	Percent of Sample
Non-Medical Sources	
Self, "Other Agency", Unclassified	11.3
Non-Physician Sources	
Self, "Other Agency", Unclassified, Health Facility	22.2
Neurologist as First Referral	
Self, Other Agency, Unclassified, Health Facility, General Practitioner	45.3

least 45.3 percent of the patients, the neurologist was the first referral, i.e., the first specialist seen.

Although it is very probably that many patients were first referred to another specialist, e.g., an internist before coming to a neurologist, the fact that the neurologist was the first referral for almost one-half of all patients strongly indicates that neurology is perceived by many as an established specialty with a defined area of competence.

Further, given the data in Table 7, it would appear that the perception of neurologists' sphere of competence, even among less "trained" personnel, is accurate. For example, patients were diagnosed as having a problem other than neurological in less than 3 percent of those cases where the neurologist was the first specialist seeing the patient. This is a lower "error" rate than is found among specialty referrals except for psychiatry. In fact, as noted earlier, the data indicate that only a very small percentage of the patients referred to neurologists are inappropriate referrals. And among this small number of "inappropriate" referrals, there are undoubtedly some who needed to be seen by a neurologist to eliminate the possibility of a neurological disease.

TABLE 7

Distribution of Cases with No Neurological Disease

Referral Source	Percent of Referrals Without Neurological Disease
Psychiatry	1.9
Non-Medical, non-physician and general practitioners	2.6
Neurosurgery	3.0
Neurology	3.1
All Surgical Specialties	3.2
Pediatrics	4.0
Internal Medicine	4.6
All Other Specialties	5.1
Total Sample: 3.4	

Finally, analysis of the sources of referrals in relation to diagnosis shows that within specific diagnostic categories, most patients come from a limited number of referral sources. One possible interpretation is that patients with these disorders are usually recognized as having a neurological disease and are appropriately referred to the neurologist. However, there are a few diagnostic categories, specifically motor neuron disease and spinal neuropathies, where the actual referrals are fairly evenly distributed among all possible sources. Possibly the neurological implications of these disturbances are initially more difficult to recognize and, as a consequence, patients are unsystematically referred to other specialists before finally being sent to a neurologist. If this is indeed the case, then this does suggest some of the areas of need in continuing education programs for non-neurologists. (Trauma to the central nervous system also manifests an even distributional pattern with respect to sources of referral, but this very likely reflects the fact that the first contact of the trauma patient with the health care system is likely to be determined primarily by propinquity and accessibility.)

Appendix V

Observations of Neurological Practice in Different Settings

There is a major aspect of neurological practice, the reality of the individual neurologist working within a specific setting to carry out his professional responsibilities, which cannot be captured by quantitative research. In order to obtain such a qualitative portrait of neurological practice, each of six neurologists, all primarily concerned with patient care but located in different practice settings, were observed by a commission staff member for two consecutive days between August 1972 and March 1973.

The decision to undertake this set of observations reflected a number of considerations. Attempts to capture, however inadequately, the feel and flavor of practice through direct observations of physicians as they carry out their professional work are, insofar as we have been able to determine, rare in medicine and non-existent in neurology. Thus, these observations should help fill a gap in the literature dealing with the nature of practice. It was also felt that the observations would probably communicate to the layman a better understanding of how clinical neurology is practiced than is otherwise possible. And finally, the reports based on these observations could serve as a useful resource in medical education, providing apprentice neurologists with a meaningful picture of the realities entailed in the practice of clinical neurology.

Selection of Participating Neurologists

The six participating neurologists were individuals identified by the members of the Task Force on Patient Care as able clinicians who are primarily concerned with patient care, who would agree to be observed and who, as a group, would represent a range of practice settings and geographic locations. Included in this sample are neurologists in solo private practice, group private practice, fee-for-service multi-specialty group practice, prepaid multi-specialty group practice, hospital-based salaried practice, and military hospital-based practice. These various practice settings are located in urban and rural areas and in the eastern, western, southern and midwestern sections of the United States.

Focus of the Observations

The primary focus of the observations was upon the use of time by neurologists—whom they see and what they do—in their professional work; data on other areas of interest were also obtained from discussions with the neurologist being observed. These included:

1. Educational background.
2. The reasons for choice of the particular practice setting.
3. The perceived advantages and disadvantages in the practice setting.
4. Views on patient care and the practice of medicine.
5. Relations to and use of ancillary personnel.
6. Relationships with other physicians.

Preparation of the Report

A draft report on each observation was sent to the neurologist involved for his criticism and review. (This was at a point when the possibility of identifying each of the participants was under consideration.) All corrections on matters of fact as well as some of the other suggestions by the participating neurologists have been incorporated into the final drafts. We have attempted to preserve the anonymity of the neurologists by excluding from the draft all identifying information, including the specific organizations and communities in which the neurologist is located. The one exception is the report on the neurologist practicing at the Mayo Clinic. Given the distinctive and outstanding nature of the Clinic, it seemed futile to try to disguise its identity.

Patient Care in Different Settings

Although the purpose of these six reports (see pages 70-98) is to provide a qualitative picture of neurological practice, some of the data on activity patterns lends itself to tabulation, specifically in terms of number of patients seen, the time spent with patients and the time spent on other duties. Even though we are using only a sample of five in this analysis (the army physician was more involved in teaching and in administrative tasks than in direct patient care), there is such great interest at the present time in the effect of type of practice setting on patient care activities that even extremely limited findings can be both interesting and suggestive.

All results of this analysis are presented in terms of a neurologist's work day, i.e., how much time a particular neurologist devotes to his various professional activities during a work day, how many patients he sees, etc. This is done by averaging the results obtained for the two-day observation period.

Table 1 compares the five neurologists with respect to the total amount of time devoted to professional activities and the total amount of time allocated to seeing patients. The solo private practitioner and the neurologist at the Mayo Clinic appear to put in the longest professional days, eleven and ten hours per day respectively. The other three averaged close to an eight-hour day. The total amount of time devoted to seeing patients also appears to vary greatly. The Mayo Clinic neurologist spent the most time with patients in a day, almost six hours while the solo private practitioner ran a close second. Since these two put in the longest professional day, this is hardly surprising. It is, however, interesting to note that the other three, even though putting in approximately the same amount of professional time, vary considerably in the amount of time spent with patients, almost five hours by the neurologist in group private practice, four hours by the hospital-based neurologist and less than three hours by the neurologist in the prepaid group. Another way of looking at the data is in terms of the percentage of professional time spent with patients. Except for the neurologist in the prepaid group, who spent only 35 percent of his time with patients, the rest are roughly similar, time spent with patients ranging from 51 to 59 percent of total work time.

Seeing patients is only one aspect of patient care. Two other activities are directly related to patient care; time spent on administrative tasks such as signing letters to or about patients, and time spent on personal or telephone consultations. (Time spent on a variety of tasks, travel, dealing with receptionists or secretaries on tasks not related to patient care, and professional activities such as reading journals is not considered.)

Table 2 compares the five neurologists in terms of the percentage of their total professional day devoted to patient-related administrative tasks, to consultations and patient-related telephone calls, and to all patient-related activities (this including time with patients as well as administrative and consultation time).

The solo private practitioner spends the least amount of time on patient-related administrative tasks, telephone calls or consultations. The other four show little difference with respect to administrative tasks but the hospital-based practitioner devotes markedly more of his time to patient-related telephone calls and consultations. With respect to all patient-related activities, the Mayo Clinic and the hospital-based neurologists devote proportionately the greatest amount of time to such activities, the prepaid group practitioner the least. (Of course,

TABLE 1

Time Devoted to Professional Activities and to Seeing Patients (In Minutes)

	Total Time in Professional Activities*	Total Time Seeing Patients	Percent of Total Work Time Devoted to Seeing Patients
Dr. A. (Hospital Practice)	480	244	51
Dr. B. (Solo Private Practice)	660	350	53
Dr. D. (Group Private Practice)	510	280	55
Dr. E. (Mayo Clinic)	600	356	59
Dr. F. (Prepaid Group)	495	174	35

* This is the average for the two-day observation period of the time devoted to observed professional activities, from the time the physician began in the morning till he finished in the evening.

TABLE 2

Percentage of Professional Day Spent in Patient-Related Activities

	Administration Time	Phone and Consults*	All Patient-Related Activities	Total Minutes Worked Per Day
Dr. A. (Hospital Pract.)	9.8	15.6	76	(480)
Dr. B. (Solo Priv. Pract.)	5.6	2.1	61	(660)
Dr. D. (Group Priv. Pract.)	12.5	3.1	70	(510)
Dr. E. (Mayo Clinic)	14.2	4.5	78	(600)
Dr. F. (Prepaid Group)	13.5	4.4	53	(495)

* Consultation in this context refers to conferring with physicians, health personnel or a family member about a patient's health problem.

TABLE 3

Average Number of Patients Seen Per Day

	Ambulatory	In-Patients	Average Per Day
Dr. A. (Hospital Practice)	6	—	6.0
Dr. B. (Solo Private Practice)	9	5	14.0
Dr. D. (Group Private Practice)	7	8.5	16.0
Dr. E. (Mayo Clinic)	11	1	12.5
Dr. F. (Prepaid Group)	10	3.5	12.5

because of the variations in length of the professional day, the order is different if we look at the absolute amount of time devoted to patient-related activities: seven hours and forty-eight minutes for the neurologist at the Mayo Clinic; six hours and forty-one minutes by the solo private practitioner; a little over six hours by the hospital-based neurologist; exactly six hours by the neurologist in private group practice; and four hours and twenty minutes by the neurologist in prepaid group practice.)

Table 3 compares the five neurologists in terms of ambulatory and hospital patients seen and the total number of patients seen. Aside from the hospital-based practitioner (who had just returned from a vacation), the differences in terms of total number of patients appear small. The neurologists in private group practice and in solo practice appear to see the most.

Table 4 compares the five neurologists with respect to the amount of time they devote to new patients, revisits and in-patients. Aside from the neurologist in the prepaid group, the average amount of time spent with new patients is roughly similar, ranging from forty-one minutes (Mayo Clinic) to fifty-two minutes (solo private practitioner). In time spent on revisits, the prepaid group neurologist again spends the least amount of time with patients but here the difference is not so dramatic. The "deviant" here is the hospital-based practitioner who devotes thirty-seven minutes on the average with revisits. (It might be worth noting that the Task Force on Patient Care recommends that a new patient should be

TABLE 4

Average Number of Minutes Spent With Each Type of Patient

	New	Revisit	In-Patient
Dr. A.	49	37	DNA
Dr. B.	52	17	10
Dr. D.	48	20	6
Dr. E.	41	18	10
Dr. F.	15	12	16*

* Includes Grand Rounds with a visiting neurologist.

allotted one to one and one half hours and a re-visit thirty minutes. Although the doctors are below these "ideal" times, the discrepancy certainly appears moderate.)

There has been no attempt to read meanings into the findings of the data given in Table 4 from a "sample of five." Yet the findings do suggest the possibility that the nature of the practice setting can be related to the nature of the neurologist's work with patients.

The six reports mentioned in this appendix follow:

Hospital-Based Salaried Practice

Dr. A., (visited August 10 & 11, 1972) who likes to describe himself as something of a maverick, spent two years in the Army after his internship and then practiced general medicine. He originally entered neurological training in order to broaden his background for practice in psychiatry but decided to become a neurologist.

Because of the gap between his internship and his residency, Dr. A. states that he identifies physicians eight years his junior as his peers. (He himself appears to be in his early 50's.) Before his move to upstate, New York, Dr. A. was at the Neurological Institute where he was considered an expert in treating a specific neurological disorder. One of the problems of being an expert, as he sees it, is that the caseload loses all of its variety. The physician tends to see primarily patients suffering from the disease he has specialized in and as a result his practice begins to lose interest. Because of this, Dr. A. started looking for some other kind of professional stimulation. He explored a variety of areas, both geographically and professionally, finally deciding to move to upstate New York where he became the only neurologist on the staff of the hospital.

This hospital is considered a unique community hospital. It serves a basically rural area. It has a capacity of 193 in-patients but its major focus is upon out-patient services. The hospital's two sources of money are an endowment fund and patient fees.

The entire professional staff at the hospital is salaried, the amount based solely on the number of years the physician has been out of medical school. Dr. A. is currently at the highest salary level possible; he cannot earn more unless all levels are raised. (He reports that his income is one-half to two-thirds less than it was in New York City.) Each physician is on an annual contract offered only after review of his previous year's work. (The contract includes a faculty appointment at a well-known New York university.) Medical staff are expected to work at least 50 hours a week.

Dr. A. states that the facilities and equipment at his hospital are in no way inferior to those at the Neurological Institute, part of a much larger medical center in a much larger city. On the staff working with Dr. A. are a neurosurgeon, a neuroradiologist and a pathologist who does brain cutting. (I do not know if he is a neuropathologist.) In terms of cost to the patient, Dr. A. charged a patient $100 an hour in New York City and now he charges $41 an hour in upstate New York.

The population served by the hospital is in the area surrounding the town in which the hospital is located, predominantly farmers and working class people. Many families live on the farms on which they work. The general economic status varies from town to town with some communities appearing prosperous, others appearing very depressed. Most of the towns have a school building which serves children from kindergarten through high school and there are at least two colleges in the area, including a State teacher's college. (These are located in two of the larger towns.) The land itself is hilly, green and sparsely populated, getting a lot of rain during the summer months and a great deal of snow during the winter. (Dr. A. notes that while the town in which he lives has been listed as one of the best cities in the U.S.A. in which to live, it is also the one that gets the least amount of sun per year.)

This town stands out from the rest of the surrounding area. It has many little museums, a large lake and lodge, an old steam engine train open to the public and on which one can ride through a few of the outlying towns; it is and looks the part of a tourist town. The population undoubtedly has a higher proportion of professionals than any of the other towns in the area.

Dr. A.'s hospital is the major medical facility in the area. Although there are a few doctors in solo practice, most people tend to use the hospital and/or its staff for primary care. Some of the other hospitals nearby relate to Dr. A.'s hospital as a medical center for the area, referring patients there as well as using the staff for consultation.

When Dr. A. came to this hospital about five years ago, there was a neurosurgeon on the staff but an internist served as neurologist. Dr. A. came here for "semi-retirement" and expected to see patients only two days a week, devoting the major part of his time to reading, studying and teaching other physicians about neurology. This proposed allocation of his time was consistent with his belief that many neurological diseases can well be managed by the family physician or internist once a neurologist has been consulted. (Neurology, according to Dr. A., should be just one area within the Department of Medicine.) However, there are some neurological diseases which he believes require constant management by a neurologist, e.g., seizure disorders.

The reality is that Dr. A. must see patients four days a week, a situation which does not leave him as much time as he had hoped for to study and teach. In addition, hospitals in the surrounding area have requested that he be their neurological consultant but time and distance prevent this. Instead, he serves as a telephone consultant. Because of his patient load, his teaching seems to be primarily confined to informal chats in the hall plus formal conferences or consultations in the evening, when he reviews the work-up on a patient. In these evening conferences he presents the symptoms which the patient is exhibiting, identifies the major disorder which these might reflect and asks for the relevant tests which might be used for deciding on a diagnosis and the priority to be accorded each possible test.

First Day

Dr. A. hopes to have another neurologist join the staff so that he can begin to spend more time teaching and reading. In the meantime, a day's work goes as follows:

Dr. A.'s first patient on Thursday morning was scheduled for ten o'clock. She was a 38-year-old woman who had been referred to him in November, 1971 by a G.P. who was leaving private practice to attach himself to a hospital. (This is occurring more and more in that area.) The referral complaint was seizures. She had her first grand mal seizure at age four. There were no more episodes until she started menstruating, when she began having seizures regularly. When she first came to Dr. A. in November, 1971 she was having two or three seizures a year, both grand mal and psychomotor. Today's appointment was a scheduled follow-up visit. For the first 25 minutes, Dr. A. and the woman chatted. She went over her activities and the times when the seizures had occurred since the last time she had seen him. This had been 11 weeks ago and she had had 11 seizures, roughly one a week. As he talked to her it became apparent to him that she was living in an uncomfortable situation. She and her husband live on the farm where he works. They are not getting along with the people with whom they share the house (the employer and his wife), the reason, according to the other couple, being the patient. However, she stated that they are crazy too and it was their problem as much as hers. Dr. A. and the patient tried to figure out a solution to the problem, which appears to be causing an increase in the frequency of her seizures. When she said her husband was looking for other work, Dr. A. called the social service department in the hospital and asked if there is a clearing house for farmers who need live-in workers and workers who are seeking a farm on which to work and live. He was given an address which he passed on to the patient; he also gave her a want ad which he had seen in a local newspaper and clipped out for her. He gave her a five-minute physical examination (B.P., heart, eyes, ears, throat, etc.) and made no changes in her medication.

The visit took about 30 minutes. After the patient left, he dictated for about three minutes and then discussed with me the many tests that are done on seizure patients by unknowledgeable neurologists. He considers much of the testing a waste of time as well as a source of unnecessary pain and cost to the patient. A good neurologist, according to Dr. A., should be able to look at the history to determine if tests are necessary. Dr. A. offered this particular woman as an example of why a neurologist should be the manager of epileptics. A general practitioner might think that one way to control this patient's seizures would be to give her more medication. However, if she were to take more phenobarbital and Dilantin she would become foggier mentally, a change which would make her more anxious and probably more prone to seizures. He believed that the dosage being given was optimal because it had maintained her for a long period and that it must be the current stress which was causing more frequent seizures. Medically, therefore, the best treatment for this woman would be to help her leave the stressful environment.

The next patient was a retired fireman, a man of 73 who in 1967 was diagnosed as having Parkinson's disease. He had been treated by a family practitioner until 1969 when he was sent to Dr. A., primarily because he, as a neurologist, was now available. The man is controlled with L-Dopa (which Dr. A. started him on) and has very little tremor or rigidity. They talked for about 15 minutes and Dr. A. gave him a ten-minute examination. Dr. A. felt the man was getting somewhat worse but that no change in medication was called for since the patient was not bothered by any of his symptoms. This was discussed with the patient.

Dr. A. examined this patient not only for parkinsonism, but also for "old age defects" such as cataracts and predictive signs of congestive heart failure. He found the beginning of a cataract, but the patient had not yet noticed it.

The next patient was a woman, age 47, who had been referred by a general practitioner. The referral complaint was weakening of the left side and stiffness, the diagnosis being Parkinsonism with complete remission (after receiving L-Dopa). Dr. A. talked with this woman for about ten minutes; she said she was doing well and could swim and engage in most activities. She was "300 percent better than when she first came." He also gave her a five-minute examination. As he finished examining her, she mentioned that she had found a lump in her breast. After examining it, he called the tumor clinic to make an appointment for her that afternoon and then called Radiology to schedule the necessary x-rays. That took an additional ten minutes of his time.

The next patient, also referred by a G.P., was a single woman, approximately 50 years of age, who came with symptoms typical of Meniere's disease. She gave a history of dizzy spells which had increased during the ten years she was in menopause (1960–1970); she also has had a hearing loss over those ten years and she reported feeling terrible all over during 1971. When questioned closely, she defined this as feeling apprehensive, in fact facing an impending disaster. She had also been operated on for a ruptured disc in 1964. Dr. A. first saw her three weeks ago, diagnosed her as an agitated depressive and put her on medication. She now reports feeling much better and planning a trip to Canada with a friend. Dr. A. thought it was therapeutically a good plan and therefore wrote a note for her to be "late for school" where she works. He took 20–25 minutes with this woman, again dictating afterwards. He said this was a good example of what he calls chemical psychotherapy. He has removed the symptoms but not the cause. As long as the symptoms are gone and the woman feels better, he will not refer her to the hospital's psychiatric unit.

After seeing this patient, he went to a departmental meeting from 12:30 to 1:25, met me for lunch from 1:30 to 2:10, was interrupted at lunch at 2:10 by the neurosurgeon and went downstairs to Radiology where he looked at the brain scan and angiogram done on a patient of the neurosurgeon's. At 2:35 he went back to his office and started seeing patients again.

An hour was spent on a 50 year old man with a gait problem whom he had seen in the hospital. Dr. A. originally suspected the man of malingering in order to stay away from work. However, after the examination he did a lumbar puncture and the diagnosis was of an arrested case of multiple sclerosis.

After finishing with this man at 3:35, he went to brain cutting, where the pathologist was to examine the brains of two patients whom Dr. A. had known. Present were Dr. A., the neurosurgeon and two other doctors. This lasted approximately 45 minutes, till 4:20, at which time he went for coffee. Dr. A. then went on rounds, primarily to provide consultation to the other physicians. Then he went home, leaving the hospital at approximately 7:45.

Second Day

I met him Friday morning at ten o'clock. Between 10:00 and 10:35 he read his mail and took care of some correspondence. The first patient was new, a referral from an internist with a complaint of headaches. He talked to the woman for about 45 minutes, during which time he read aloud the letter he had received from her physician, a close friend of his. Then he examined her for approximately 20 minutes. Immediately after the examination he talked with her for an additional five minutes, wrote a letter to the referring physician and dictated for another five minutes. In all, he had spent one hour and 15 minutes with this new patient.

The next patient was also new and also referred by an internist. While living in Chicago, she had had several episodes of what could have been psychomotor seizures. She was seen by a neurologist and a psychiatrist in Chicago but a conclusive diagnosis could not be made. The psychiatrist gave her verbal treatment, the neurologist gave her an anticonvulsant. Dr. A. ordered an EEG "for the record" after talking with the patient and her husband for almost an hour.

Dr. A. told them he did not feel she was experiencing seizures. He did not examine her because he felt this would contradict his statement to her that she was not an epileptic. He felt that he was essentially "making friends" with her and her husband.

Shortly after 1 o'clock we went to lunch, returning at 1:45 to see an 18 year old epileptic boy for his scheduled follow-up visit. The patient and his sister discussed his home life, which appeared to be a major factor in his having frequent seizures. During this 30 minute discussion, various plans were presented by Dr. A. These plans were more in the line of social counseling than of strict medical counseling. Dr. A. made a slight change in the boy's medication. After the patient left, he spent 15 minutes talking with me and dictating.

The next patient was one Dr. A. called the 26 year old "schizophrenic man" who had been sent in from the plant physician. As it turned out, the man has had stomach pains and a severe headache as well as a history of at least three temper tantrums (which were not without provocation). The diagnosis was a frightened plant physician and no known neurologic disease for the young man.

The next patient was a follow-up visit by at 67-year-old man with trigeminal neuralgia. Dr. A. spent approximately 20 minutes with this man, examining him and talking with him about the symptoms he had had earlier and how everything was under control now. Part of the examination involved showing simple diagnostic procedures for my benefit.

At 3:45 there was a follow-up visit, a pregnant woman with psychomotor seizures. He spent 55 minutes with the woman and her husband, primarily, I believe, because he enjoyed talking with the husband. A very brief examination was given and another follow-up visit scheduled for just before her delivery in October.

At 4:40, there was another new patient, one whom he had seen in the hospital. Dr. A. believed insufficient Vitamin B12 had caused a major part of the patient's problems. However, he also felt that some of the other problems she was having (e.g., dizziness) were due to emotional stress. The woman had told her own physician "she had no problems" but when questioned closely by Dr. A. she did discuss her family situation. After much discussion, he convinced her to make an appointment with a psychiatrist at the hospital.

This was the end of the working day for Dr. A. I neglected to ask him whether or not he had patients in the hospital. However, it is quite likely that he did not because he had just returned from his vacation three days before my visit.

As can be seen, Dr. A. spends a great deal of time talking with patients. Part of this was undoubtedly because I was present and, as he stated, he wanted to give me a clear idea of what a neurologist does. His strictly medical examinations are quite brief and that is probably in keeping with his usual practice. All in all, it is undoubtedly true that he acts as a regular family doctor and social counselor, partly because this is congenial for him, partly because of local custom in this area where patients see their physician, even the specialist, as a family physician.

Personally Dr. A. would prefer to work less and pursue his hobbies more. And with respect to the work he does, he would also like to devote more time to teaching physicians how to manage neurological patients who need not be managed by a neurologist, e.g., the parkinsonism sufferers he sees now. However, one of the problems he encounters in this regard is the relative scarcity of physicians in the area of upstate New York in which he practices.

Solo Private Practice

Dr. B. (visited August 16 & 17, 1972) went to a medical school in the southeastern United States, was both an intern and resident at a New York City hospital and finished his residency training in another hospital in New York City. He was part of a large group practice in the Midwest and left to begin a solo practice in the southeast. His reasons for this move were varied.

Dr. B. was not satisfied with the particular group practice he worked with. In general, he believes that there are a number of advantages to the physician in a well managed group practice. First, there is no need for a doctor to be constantly on call; this is a duty which is rotated. Second, the burden of administrative problems is removed from the physician if there is a good administrator to handle them. Unfortunately, neither of these advantages was in operation at the particular clinic with which he was associated.

As far as the advantages of group practice for the patient are concerned, he believes that it can provide multifaceted medical service at less cost. Further, the total case history is at one location in one chart. However, he also believes that there is one major disadvantage, e.g., that a physician cannot refer the patient to a doctor outside the group.

When Dr. B. started his solo practice, he was the first and only neurologist in the community. Since then the number of neurologists has tripled and there are five neurosurgeons. Apparently, there are enough patients in the community to keep all of them busy. For example, Dr. B. devotes approximately 75 to 90 hours per week to professional activities. The major part of this time is spent in patient care. He sees patients in his office, in the two hospitals with which he is affiliated, in a rehabilitation center and in a nursing home, all of which are located close to his office. He functions as both a primary care and consulting neurologist, seeing approximately 60 new patients a month.

Because Dr. B. enjoys teaching, he spends one day a month teaching at a university, a two-hour drive each way. He looks forward to the possibility of a university medical school setting up classes in the community in which he lives. Dr. B. is also active in a local cerebral palsy clinic located in the rehabilitation center. He is an active member of the AAN, the American Society of Internal Medicine and of a group of 50 neurologists who receive at least 51 percent of their income from private practice and are concerned with the problems encountered in private practice. He is an officer in at least two of these organizations. When asked when he had the time to keep up with the literature, he replied between 11 and 12 at night.

Dr. B.'s patients come from a population of approximately 500,000 people within an 80 to 100 mile radius of the city. Within the city itself there are two large voluntary hospitals, a proprietary hospital and a rehabilitation center with in-service and out-service patients. The total number of hospital beds represented by these facilities is approximately 1,200 to 1,500. The two voluntary hospitals have EEG laboratories with trained technicians, radiology departments and intensive care units.

Dr. B. reported a number of problems in the community's medical facilities. The administrator of the older of the voluntary hospitals makes decisions as to medical services without consulting the physicians on staff, a tactic which not only antagonizes the medical staff but leads to delivery of inferior or inefficient medical care. For example, the administrator decided to have only private rooms in the new wings recently added to the hospital. This has lead to manpower waste because a nurse must go from room to room rather than being able to care for two patients in the same room; also, patients have encountered financial problems because most insurance programs will not cover the full cost of private rooms in the hospital. Further, the administrator has purchased many pieces of new equipment for the laboratory, patients' rooms and intensive care units. Unfortunately the staff using the equipment does not always know how to repair it if a breakdown occurs. Dr. B. asked a nurse if anyone knew how to repair one of the life maintaining devices which was being used; it turned out that no one in the hospital knew how to repair it. (As a result of Dr. B.'s request, staff members were taught how to repair the various machines.) The "political" problems, as Dr. B. likes to refer to the above, have caused dissension and alienation among the physicians on the hospital staff.

Within the past year Dr. B. was replaced as director of the EEG laboratory in the same hospital by another neurologist. Dr. B., who is very knowledgeable about EEG machines, was teaching the technicians how to administer an EEG and to repair the machines. The neurologist who is currently supervising the laboratory has very little, if any, knowledge regarding the administration of an EEG and the repair of a malfunctioning machine.

Dr. B.'s office suite is located in a medical building; it includes two examination rooms, one EEG room, two clerical or typist rooms, his office, a waiting lounge and a room for storage. His staff consists of two part-time receptionists (his wife and his daughter), one typist and one EEG technician. A computer service does his billing, tabulates how many patient fees have been collected and how many EEG's are done. Printouts of this information are given monthly with cumulative figures. The cost of this service, including the terminal in the office, is approximately $2,100 a year. This saves him the cost of one more typist or billing clerk. According to Dr. B., he spends less than 35 percent of his income to maintain his office, which is in keeping with the financial guidelines for private practice given in Medical Economics.

First Day

On Thursday morning I was picked up by Dr. B. at 8:15 in order to begin hospital rounds at 8:30. The first thing he did when we arrived at the hospital was to page the intern assigned to him to meet us at the EEG laboratory to review an EEG on a patient whom Dr. B. had recently admitted. He spent six minutes reading the EEG and then dictated his impressions on a dictaphone. Dr. B. and the intern then looked at brain scans for six minutes.

The first patient seen was a young man who had either had a seizure or had fainted. (He was admitted through the Emergency Room.) Dr. B. spent about ten to fifteen minutes discussing the patient with the nurse and talking to the patient's mother. The patient was anxious to go home but Dr. B. convinced him to stay at least for his EEG scheduled that afternoon. He suggested to the patient that he temporarily not follow through on his plans to get married because worry over this approaching event seemed to be causing his current medical problem.

After leaving the patient, Dr. B. then spent three minutes in the corridor with a physician discussing a patient who was to be seen by Dr. B. the following day. He was then stopped by another physician who wished to discuss a patient in the hospital for whom he wanted Dr. B. as neurological consultant. Dr. B. went immediately to the intensive care unit to see the patient. He read the chart and examined the patient for about ten minutes. An additional four minutes were taken to write up the findings of his examination.

Dr. B. then left the hospital and went to the rehabilitation center to attend the cerebral palsy clinic. However, Dr. B. had made an error in the dates and there was no clinic. He and the intern then went upstairs to see his two patients in the center. After talking to them (one post-stroke and the other post-operative), he discussed their treatment with the physical therapist.

At noon the intern went back to the hospital and Dr. B. and I drove around the city. We arrived at his office at 1 p.m. For the first half hour he answered phone messages and read his mail.

His patients who feel that they are emergencies but do not have an appointment are told to come to his office at 1:00 p.m. At 1:30 he saw his first office patient, an "emergency." The patient was a seven year old boy who recently had surgical removal of a brain tumor. Dr. B. devoted a total of 20 minutes to this patient's care. This included examining the patient, dictating his findings, talking to the mother and instructing his staff to arrange to have the boy admitted to the hospital.

His next patient, a first visit, was a woman who had had seizures since childhood, prior to the discovery of Dilantin, and who had had to drop out of school and was unable to function normally. In 1941 she was put on Dilantin which brought her seizures under control. Her medication was last changed in 1942. The woman, accompanied by her mother, talked with Dr. B. for a half hour prior to his 15 minute examination. In line with his procedures, an EEG had been done on her earlier in the day and the results were ready for him to study. After examining the patient and the EEG results, he again talked with the patient and her mother, made a slight change in her medication and then dictated notes on the case for about four minutes. He then dictated his impressions on the EEG onto another dictaphone. The total time spent with the patient was approximately an hour and ten minutes.

It was now 3:30. His next patient, also a first visit, was a seven-year-old boy referred primarily for behavior problems which a psychologist who had tested him felt might be the result of some organic brain damage. After examining the patient and the EEG, Dr. B. talked with the mother. His impression was that there was no neurological problem, only an emotional one, and he referred the mother to a counseling service in town. He spent approximately one hour with the patient and his mother.

The next patient, again a first visit, was a woman complaining of a pain in her back which radiated down one of her legs. After examination and discussion, he felt she should have x-rays taken. He called the radiologist, whose office is down the hall, and immediately sent the woman to him. Because this service is nearby, he would be able to view the x-rays and have a diagnosis later in the afternoon.

It was now 5:05. By using both examining rooms he saw two follow-up patients in the next 25 minutes, both boys with seizure disorders.

At 5:30 he went to the radiologist's office, talked to him, looked at the x-rays and then walked back to the office.

At 5:40 he saw his next patient, a follow-up visit for a woman suffering from vertigo who had first been seen by Dr. B. one year ago. He spent approximately 20 minutes with her.

He then saw the woman with the back pain who had been x-rayed earlier. He discussed the findings, prescribed exercises and gave her an instruction sheet.

He left the office at 6:30 and went to the hospital to see the seven year old post-operative boy whom he had admitted earlier in the day. After approximately a half hour he left, going to the nursing home where he visited a 35 year old man with epilepsy. His physician had requested that Dr. B. visit the patient to see if a change in medication could reduce his seizures, which were occurring at a rate of about 100 per day.

Second Day

The next morning Dr. B. picked me up at 7:35 to attend a staff meeting at the hospital which was scheduled from 7:45 to 8:45. A guest speaker was there to talk on "slow virus." After the meeting Dr. B. spoke briefly to the primary physician for the patient seen in the nursing home. Dr. B. and his intern then went to the EEG laboratory where there were two EEG's to be read. He visited a patient in the intensive care unit and then went to the rehabilitation center where he saw his two patients. The intern went back to the hospital while Dr. B. drove to the other hospital to visit the seven year old boy. After visiting the patient and talking to his mother he went to the EEG room and looked at the results on the boy. At 10:15 he left the hospital for his office.

After tending to office business, he saw his first patient, a follow-up case, at 11:30. His discussion with the patient, the examination and dictation took from 11:35 to 11:50.

His next patient was a return visit, a man with burning feet. He spent ten minutes with this man.

The next two patients were also return visits, both with migraine headaches.

At 1:20 a new patient came in complaining of severe headaches. An EEG had been done earlier. Dr. B.'s routine is to look at the EEG, talk to and examine the patient, reexamine the EEG while the patient is dressing and then discuss his impressions with the patient. When the patient leaves, he dictates.

The next patient was also new, a woman complaining of pain in her back which radiated down her leg. After his examination, Dr. B. diagnosed a herniated disc and made arrangements for her to be admitted to the hospital on Sunday, three days later. The delay in admission was at her request.

The next patient, at three o'clock, was a young man whose main complaint was "chest pain." It quickly became obvious that the patient, who was a self referral, was not in need of a neurologist. According to Dr. B. one of the problems with self or lay referrals is that frequently the patient is not in need of a neurologist. The visit is a costly error for the patient as well as a waste of the neurologist's time.

At 3:50 Dr. B. saw his next new patient, a young woman. After examining her and the EEG, he diagnosed her as suffering from migraine headaches. He spent 40 minutes with this patient.

From 4:30 to 4:45 he was with an epileptic boy and from 4:50 to 5:05 with a headache patient, both return visits.

He then spent 20 minutes returning phone calls. His last patient of the day was a two year old girl who had fallen a few days earlier. She was being seen then because a bruise and swelling had just begun. She was seen at 5:40 and would have been seen earlier but it had taken a very long time to do the EEG. He finished the examination and his dictation at 6:45 and left the office for the day.

Military Hospital-Based Practice

Dr. C. (visited January 11 & 12, 1973) lives a few blocks from the Army hospital with his family. He has been in the Army since his last year in medical school, when he needed money to complete his education. He joined so that the Army would pay for his medical training. Asked why he had stayed in the Army, he replied that he likes the Army. He feels that the pressures in the Army are different from the pressures on the outside and that he prefers those encountered by an Army doctor. For example, there is less pressure to maintain status in the Army; your position is your rank and everyone is aware of it. Further, you do not have to consider the cost of treating the patient, a factor which can be a hindrance in private practice outside the Army. And as the demands for paperwork have increased for other practitioners, they have been held stable or even simplified in the Army; this "traditional complaint" can no longer be considered a disadvantage. An additional advantage he mentioned is that in three years he will have 20 years of service and can retire with about $1,000 a month pension for the rest of his life. The longer he stays in, up to 30 years, the more retirement benefits he'll receive. Dr. C. currently earns the equivalent of $35,000 annually.

According to Dr. C. the chief disadvantage of Army service perceived by young doctors is the low pay. A resident in the Army earns approximately $15,000 a year; junior staff members (physicians who have completed their residency elsewhere and have come to fulfill their two-year commitment to the Army) earn about $22,000. The upper range would be the equivalent of $40,000 (equivalents include such prerequisites as housing, access to a P.X., etc.). A junior staff member does not usually remain in the Army after his two years. The main reason given, again according to Dr. C., is the relatively low pay. However, those who take their residency training in the Army do occasionally stay because they get used to the Army, like the way it works and are willing to take the lower salary for the position they have.

He described the caseload at his hospital as consisting of one-third active duty military personnel and two-thirds dependents and retired people. The patient mix is somewhat different from most Army hospitals; many of the patients seen are individuals being considered for medical separation from the Army. These can include, in addition to individuals suffering from service-connected disabilities, those near retirement whose health status needs to be evaluated because of the relation of health to retirement benefits, and young men whose medical problems were not picked up at the pre-induction physical. An example of this latter case is epileptics who do not tell about their epilepsy so they can join the Army as an "ego-booster" because they have been excluded from things in civilian life. However, if they find Army life unpleasant, they will stop taking their medication and begin having seizures and request to be medically separated.

Another difference between this hospital and most Army hospitals is that this hospital is similar in many ways to a university hospital. Dr. C. has three junior staff neurologists and two residents in each year of residency. The junior staff was selected by Dr. C. Neurological cases of special interest are sent to this hospital from other Army hospitals. A more typical Army hospital is one about 40 miles away where there is one neurologist seeing half the caseload that is seen here.

He believes that 90 percent of the cases seen at the other Army hospital do not have neurological disease. Dr. C. conjectures that the percentage is high because of the accessibility of physicians. He further states that physicians see more patients in the military service than they would on the outside but spend less time with each patient because of the nature of their problems. Few cases have neurological related problems.

In addition to treating patients in the hospital, the residents and staff also run a neurological clinic which is held daily from 1 to 4 p.m. The neurology staff supervises the clinic on a rotational basis. A second year resident is assigned to the clinic full-time and handles a large portion of the caseload. The other residents rotate through consultations. The residents rotate to neurology services at a general hospital and at the local university.

Dr. C. gave me some statistics for the neurology service. From September 1, 1971 to August 31, 1972 there were 578 primary care patients and 407 consults in the hospital. There were 1,329 initial visits and 3,122 return visits for a total of 4,451 in the clinic.

In addition to visiting with Dr. C., I spent some time with Dr. R., a staff member who was in charge of the clinic for the two days of my visit. I asked him if he planned to stay in the Army and he said no. I then asked him why and he said that he was concerned with both money and stimulation. He felt that the Army doctors were not really "gung ho," not very stimulating. Dr. R. is also interested in research and teaching. He doesn't feel he could teach and do research in the Army and he plans to go to a university. The two other staff members, according to Dr. R., are also leaving the Army. One is going into private practice and the other into a university setting.

First Day

At 8:00 a.m. (Thursday) I met Dr. C. in his office as he was getting ready for Grand Rounds. Before we left his office one of the residents dropped in to discuss a patient. They continued their discussion while going upstairs to the meeting (which included all the staff members and residents). The meeting began at 8:20 with a presentation of a resident's patient. At 8:30 the group went to see the patient being presented, a 70-year-old woman who had suffered a stroke. Dr. C. and Dr. R. examined her from 8:30 to 8:45. The group returned to the conference room to discuss Dr. C.'s and Dr. R.'s findings and the resident's thinking. The discussion was directed toward a final diagnosis and a plan of treatment. Dr. C. discussed with the residents certain treatments that they might try with the patient more for teaching purposes than for therapeutic purposes. Treatment which is of unproven value is acceptable for trial so long as it would not be harmful to the patient.

At 9:16 they started discussing the second patient, a 47 year old woman. The resident presented material from the chart and the others who had seen the patient added their findings. Unfortunately the x-rays were missing (apparently a not uncommon occurrence here). There were suggestions from Dr. C. and they finished discussing this patient at 9:45.

At 9:45 they started to consider the case of a 19-year-old male who had been struck with a high tension wire some four years ago while raising an antenna on a ham radio. The electricity entered at his neck and went out through his left buttock. He enlisted in the Army and went to Fort A. It was the feeling of the residents that he was requesting a medical separation from the Army because he had not been assigned to the type of work he wanted. He was admitted here to determine the extent of nerve damage from the electrical injury. At 10:05 they went to the patient's room. Dr. C. examined him and asked him to do a few exercises such as running and walking.

He finished examining the patient at 10:20 and talked about objective findings until 10:30. The group went back to the conference room, but it had been taken over and the meeting was perforce continued in the hallway. During this time Dr. C. was called away for a telephone call. When he came back he stated that they were going to have to hold a bed for a general with a possible CVA. The conference terminated at 10:50.

At this time we returned to Dr. C.'s office where we chatted and discussed the operation of the hospital. He told me how different the practice was at Fort A compared to here and how the neurologist there had to work much harder than was necessary here at this hospital.

Dr. C. also took this time before lunch for administrative duties. He was interrupted at one point to go over the budget for the following year. I would judge that much of his time is spent on administrative details.

We discussed briefly the rotation of the university students and the problems generated by their styles of dress and grooming, the "long hair and sandals syndrome." Dr. C. stated that while the students had been offended by and unwilling to comply with requirements issued by the hospital command that they meet certain standards, he had, prior to this proclamation, usually managed to get them to respect his personal requirement that they be clean, well groomed and professional in appearance in order to see his patients.

Dr. C. escorted me to Dr. R.'s office and then went off to a meeting. Dr. R. told me that most of the patients are scheduled; very few unscheduled patients are seen. It is up to the staff doctor to see the "pips," pre-induction physicials. These are young men who are being evaluated for neurological conditions or complaints to determine their fitness for induction into military service.

The office in which he examined patients had a desk, examining table, x-ray viewer and an instrument cart on rollers. It was about 100 feet from the waiting room where Dr. R. would go to get the patients.

The first patient was a 19-year-old male who had a .22 calibre bullet lodged in "L_4," the result of a gun accident in 1967. The patient gave back aches as a symptom. Through questioning Dr. R. found that this young man's job involved a lot of lifting and this as well as sitting gave him back aches. Dr. R. talked with and examined him for a total of about 20 minutes. After the boy left, Dr. R. said he would not be disqualified from the service for neurological reasons. Dr. R. spent about seven minutes writing up his findings.

A resident then came to the office asking for advice on a patient he was seeing. Dr. R. spent about one minute with the resident.

The second patient, seen at 1:56, was the wife of a colonel; she was referred by an internist and an ophthalmologist. The woman was experiencing double vision. Dr. R. talked with the patient and her husband for about 30 minutes, did an examination for about 20 minutes and talked again with the patient and her husband. He was interrupted by one phone call. The tentative diagnosis was neurological difficulty due to diabetes, although Dr. R. thought it could be a brain tumor.

From about 3:00 to 3:25 he disappeared. He had gone to the waiting room to get the next patient and had met a radiology resident who wished to discuss his numb toe. They decided the numb toe came from pressure on his leg from his ski boot.

He had also consulted on a patient who had sensory induced epilepsy (a certain pattern of light flashes producing a seizure). This reminded Dr. R. of a man he had seen who was a helicopter pilot. When the pilot would look up at the sun coming through the rotating blades, he would have a seizure.

At 3:25 he saw a 50-year-old woman with myasthenia gravis to check on her progress. She was complaining of pain in her head, probably due to sinus. Dr. R. examined her sinuses, suggested she be seen at the ENT clinic and scheduled her for a revisit in four months. At 3:45 the patient left and he wrote up the findings in the chart. Dr. R. finished up in the clinic and talked with another physician for a few minutes, then read an EEG with a resident and headed for the hospital to see a patient.

Second Day

At eight o'clock Friday morning, the Officer of the Day reported for half an hour. At 8:35 Dr. C. went off to see the general for whom they had held a bed, a 46-year-old African who had come to the United States to take a course being given in a nearby town. On Tuesday (three days earlier) he had collapsed while eating breakfast and was unable to speak or use his left side for a while. He had been taken to the hospital and examined but no abnormalities were found. The patient had been admitted to the hospital the day before and worked up by a resident. From 8:38 to 8:55 Dr. C. read the chart, then went in to talk to the patient and examine him. At 9:20 Dr. C. finished and went to another room to discuss his objective findings with the resident. One possibility was that he had hyperventilated. Another possibility was an upper motor neuron lesion. They also suggested that it might be hypoglycemia, based on his spending 28 hours on the plane, arriving late Sunday and possibly not having much food available to him on Monday (a holiday). The diagnosis they favored was a TIA.

At 9:40 Dr. C. went back to the general's room to discuss their impressions with him. Dr. C. suggested to him that he stay for extensive tests so they could clarify what had caused this episode. His other choice was to leave the hospital and continue with the course. The general decided that he wanted to stay and get to the bottom of his problem.

At 9:50 Dr. C. left the patient to review the necessary tests with the resident and to discuss another case. At 9:57 he went downstairs to review the general's condition and his own recommendations with the deputy commander, who would inform Washington that the general was at the hospital and that tests had been ordered. Washington would then inform Ethiopia to ensure that the plan of action was acceptable to the two governments.

At 10:05 Dr. C. returned to his office before going to the pathology lab for brain cutting. Two brains had been prepared. The neuropathologist first reviewed the cases and then asked the residents what they would expect to find. He then cut the relevant parts of the brain, showing the pathology that caused the described symptoms.

(While cutting into the first brain, the pathologist also cut into the tip of his finger. The pathologist continued cutting after changing his gloves, frequently placing the obviously injured finger behind his back.)

At 1:00 p.m. I went with Dr. R. to the clinic, as I had done the previous day.

The first case was a "pip," a 19-year-old male who had jumped off a truck when he was nine years old and apparently fractured his skull and suffered a concussion. His complaint was that he had a "soft spot in his head" towards the back that hurt when he pressed it. He also complained of getting headaches when he played football. He ran track and did pole vaulting, setting a record in high school. He was graduated from high school in 1971, is now an apprentice in carpentry and is planning to get married. Upon questioning he disclosed that he drank sometimes, had a "violent temper," didn't like to be told what to do, occasionally goes crazy when told what to do and has used drugs. He emphasized that he wasn't on drugs but that he had used them. Dr. R. looked at his x-rays; while he was doing so, the boy again said, "I don't like to be told what to do." Dr. R. ignored all of this and continued looking at the x-rays. He then had the patient get up on the table so that he could do a physical exam. While Dr. R. had the stethoscope in his ears, the boy said, "If you really want me to tell you what drugs I've taken, I'll tell you." Dr. R. did not hear (him) and the boy repeated his statement when Dr. R. could hear. Dr. R. showed no interest but the boy finally did mention the drugs he had taken and also said that he wasn't on any drugs now.

Dr. R. finished with the boy at 1:45. The impression was that he was a fairly well integrated youth who was threatening violent behavior if drafted. However, given that he was disciplined enough to have a B average in high school, had set a pole vault record, was working steadily and planning to get married, it was assumed that he probably only had poor impulse control and need not be excluded from the Army for this.

The next patient, at 2:10, was a 43-year-old wife of an enlisted man. She complained of having headaches on the left side of her head. In the last year or so she would wake up with headaches which she thought were sinus induced. When she went to the ENT clinic four days earlier, she was told they were not sinus headaches. The first gynecologist who examined her thought the headaches were caused by "the pill."

At 2:20 Dr. R. was interrupted by one of the residents about another patient. He went off to examine the other patient and stayed there until 2:55. He then came back to the woman and gave her a diagnosis of vascular headaches. Dr. R. talked with her till 3:15 and then spent another eight minutes writing up his findings and a prescription and ordering lab tests. At 3:23 he went out to the waiting room to give the prescription and the lab test requisitions to the patient and then came back to his office.

At this point he was done and we stayed and talked for a while about why he was planning to leave the Army.

I went back to see Dr. C. but he had finished with his meetings for the afternoon and had left.

Group Private Practice

The city in which Dr. D. (visited January 15 & 16, 1973) practices is considered by its inhabitants to be a midwestern town. It has a population of 50,000 and a twin city, located on the opposite side of a small river, with a population of 30,000. Dr. D.'s community was written up in the local newspaper as one of the 50 safest towns in the United States. The sheriff was quoted as saying that he felt this was due to the concerned and conservative citizens of the town. According to Dr. D., there is a one-block skid row but no minority group residents other than American Indians and a few Black students at the state college.

There are three colleges in the nearby area, a Lutheran college and two state colleges, one a science and the other a liberal arts college. The city has four hospitals including a Veterans Administration Hospital.

Dr. D., who lives in a pleasant neighborhood with his wife and children, served in the United States Navy before entering a midwestern university as an undergraduate. He went to medical school at a midwestern university and did his internship and a two-year residency in medicine before entering a three-year neurology residency. His goal was to join a private group in neurological science in the area he now lives in.

Dr. D.'s group is located on the basement level of a tastefully decorated four story brick building. Each neurologist and neurosurgeon has his own office. They share the examining rooms, using a colored flag system to indicate that the room is occupied. Dr. D.'s office, although not large, is very nicely furnished. He has a small white couch, wood bookcases and a large desk and two chairs. In the time I was there, he did not see any patients in his office, only in the examining room. Each examinining room is also tastefully decorated, minimizing the strictly medical appearance found in many examining rooms. In his office, Dr. D. has access to a dictaphone. Each doctor is also helped by a secretary. The other floors of the building house psychiatrists, at least one psychologist and, on the third floor, clinical laboratory equipment, the EMG, x-ray and EEG machines. Dr. D. is a trained electromyographer and he performs all the EMG's. The EEG machine is manned by a technician. The building also houses a mental health and mental retardation center.

On the basement level there is an extremely attractive atrium. Opening off the atrium is a large room where the staff can have coffee and hold meetings and parties. There is also a library in the building.

Dr. D.'s group draws patients from the entire state. Until two years ago there were only two neurologists in the state. Now there are six, three at the neuropsychiatric group. Because of this increase, a three-month waiting period for appointments at his group has been cut to about one month. Emergencies are squeezed in. The three neurologists rotate the "on call" duty. Dr. D. is on call every third week. In addition, there is a stroke team meeting every Tuesday morning which the neurologists from the group chair on a rotating basis. The responsibility for Grand Rounds on Wednesday mornings in also rotated.

Dr. D. likes group practice very much. The reasons he gave were the rotation of "on call" coverage, the availability of instant consultation (in the office) and the stimulation of having all the neurological sciences around him. He was not sure, however, that it provides a more efficient or economical way of running an office than solo practice.

At the Hospital, an office is provided for the doctors in the group. While I was there, Dr. D. used this office to dictate material on hospitalized patients and to read EEG's, both on his patients and on those of physicians outside the group. (Reading EEG's as a consultant is also rotated among the three neurologists.) Dr. D. mentioned that he has EEG's done on all head problems.

First Day

Dr. D. picked me up at the motel to take me to the hospital at 8:45 a.m. At nine o'clock he began seeing his hospitalized patients. The charts are kept at the nurse's station in a large wheeled cart. The nurse rolls the cart down the corridor, following the physicians. Dr. D. began rounds with the nurse, the cart and an intern.

The first patient was a 30-year-old man who had had many symptoms over the past few years but for whom a firm diagnosis had not yet been made. His current hospitalization was for contrast studies to rule out a brain tumor. The studies were negative. Today he complained of nausea, vomiting and a very painful left heel cord. Dr. D. ordered medication and physical therapy for him.

At 9:05 he went in to see a 67-year-old man who had had a stroke, finishing with him at 9:07. The patient was to be discharged today.

At 9:07 he saw an 82-year-old man with stroke, possibly suffering from pernicious anemia. He had been on vitamin B12 shots and had been going to physical therapy for his gout (in thumb joint and finger). While Dr. D. was with the patient, two of the patient's daughters came in. He spent about ten minutes with them, discussing the patient's general condition and why the patient appeared disoriented. Dr. D. explained that the disorientation was a reaction to a specific medication which had been discontinued and should not be viewed as indicating that the patient was getting worse. Dr. D. stated that the patient will need care when he does go home and suggested that the daughters contact social service to discuss the options open to the family. (This particular patient does have a great deal of money; in fact, he built a nursing home near his house but refuses to enter it as a patient.) Dr. D. left the room at 9:25.

At 9:27 he saw a 65 year old man with Guillain-Barré syndrome for about one minute.

Dr. D. then went to the floor where the physical therapy department is located. The first patient he wanted to see was a 62-year-old man who had suffered a stroke and had been left with considerable residual weakness in his arm and leg. Because the patient was not in his room. Dr. D. walked down the hall to the physical therapy room. The patient was there, being taught how to dress himself. It was the first time the patient had tried this task and he was finding it a difficult and frustrating undertaking. Dr. D. spent about one minute with the patient and then went out to the hallway where the patient's wife was waiting. He discussed with her how much she should expect her husband to recover.

He then went up one flight of stairs to see a patient for a consultation. A few minutes later, at 9:45, he was ready to leave the hospital and went downstairs to the coat room. However, he was detained by a brief consultation with another physician in the hall. Then Dr. D. recalled that he still had to dictate a discharge summary and went to the office containing the dictating machine.

He then drove from the hospital to his office, a trip of five to ten minutes.

At 10:10 Dr. D. saw his first office patient, a 25 year old woman referred by an orthopedist for an electromyogram. She had experienced sudden weakness in her right shoulder upon waking one morning a few weeks earlier. The only cause she could associate with the weakness was strenuous bowling the night before the onset. During the history, she mentioned that about five or six years ago she had a "drooping lip which was cured with shots." The discussion with the patient and the EMG were completed at approximately 10:45. Dr. D. then went downstairs to dictate.

At 10:50, Dr. D. looked at the chart of his next patient, a 55 year old male epileptic who had originally been referred by the Vocational Rehabilitation Administration and who was returning now for a recheck. Dr. D. read the current EEG and dictated his impressions until 10:55. Then he went to the examining room to talk to the patient and examine him. He rescheduled the patient for an appointment in six months. Dr. D. asked the patient if he needed forms for the VRA. The patient said that he had been told that "they were unsure if he would be able to continue with them because the budget was being cut back or some such thing." Dr. D. said he would send a report to Vocational Rehabilitation along with his recommendations and asked the patient to contact him if he continued to have problems with them. He finished with the patient and his dictation at 11:02.

At 11:02 he started signing letters and gave information regarding the status of his hospitalized patients to his secretary. Two patients called during this time and he gave one of them an appointment for the next day.

At 11:06 he saw a 62-year-old man with a pain in his left shoulder who, after being referred by his family doctor, had called for an appointment about six weeks earlier. On July 2, 1972 he had fallen on his shoulder while playing football with his grandson. He saw a physician at that time for the pain but no treatment was given. Between July and October his discomfort increased and movement in the shoulder and arm became slightly impaired. In October pain started in his "upper spine" and the injured shoulder, radiating down his arm; his little finger became numb. At that time he returned to his doctor who in turn referred him to the neurology clinic. (Because his physician did not consider his case an emergency, he had to wait for the first open appointment rather than be seen immediately by Dr. D.) The pain had become less severe since October. They talked until 11:25 and then Dr. D. returned to his office while the man got undressed. Dr. D. dictated until 11:30, went back to the examination room and examined the man until 11:42. He told the patient he wanted to do an EMG and went out to one of the secretaries to ask that the man be escorted to the EMG room. He dictated his physical findings and at 11:46 he started the EMG as a diagnostic procedure to determine the functioning of the ulnar nerve. He finished with the EMG at 12:10. Dr. D. ordered x-rays and said he was considering a myelogram to be done in the hospital by one of the neurosurgeons. He said he would see the patient later that afternoon and went back down to his office.

There he received a telephone call for a pediatric neurology referral. He asked that an appointment be scheduled for the caller with a pediatric neurologist. At 12:15 he began dictating his findings from the EMG finishing at 12:20. He then left the office and went home to eat lunch with his wife. We took a longer lunch than Dr. D. usually does but arrived back at the office at 1:10. At that time Dr. D. answered a telephone message.

At 1:15 he saw a 44 year old woman complaining of headaches who had been referred by an internist in town. She had had her first headache in 1964; the headaches start above her right eye and then move to the whole head. During the headaches her ears are plugged, she feels like fainting and has the sensation that she is "walking sideways." In response to questioning she stated that she had had no vomiting, has constant pain without throbbing and that the duration of a headache is from three days to a week. She has not had to miss work because of these headaches. The headaches occur about once a month and she had tried to observe whether they were related to her menstrual cycle, stress, cold or any other recognizable precipitant. Dr. D. finished talking with her at approximately 1:25. He then went to his office to dictate the history while the patient undressed. At 1:30 he returned to the examining room and examined the patient for ten minutes. He told her he wanted her to have a head x-ray. Because she had a 2 p.m. hair dresser appointment, she asked if she could come back later. Dr. D. agreed. Dr. D. went back to his office and dictated until 1:42. He read th EEG that had been done on this patient and dictated his impressions until 1:50. Based on the results of her EEG, Dr. D. decided she needed a brain scan and a lumbar puncture. He would discuss these with the patient when she returned for her skull x-ray later than day.

At 1:50 he began reviewing the chart on the next patient, a 49 year old woman complaining of weakness in her left arm. Although no definite diagnosis has been made of this woman's condition, she has had this symptom for three years. She was here for a repeat EMG which Dr. D. finished at 2:20. He then talked to both the patient and her husband about hospitalizing her for a myelogram (to be done by a neurosurgeon). The couple agreed to the hospitalization. Dr. D. then went down to his office to dictate and to write up the admitting orders, finishing at 2:32. He was interrupted once by a phone call referring a pediatric neurology problem from another physician in the area. At 2:32 he studied x-rays of the woman's arm (done that morning) and attempted to see a neurosurgeon regarding the patient. He did talk with a neurosurgeon but to discuss a request of the neurosurgeon that he be the examiner of Medicare cases. He finished that discussion at 2:45 and resumed his dictation, completing it at 2:46.

He then saw a 55-year-old man with spinal cord disease. His legs were weak and he required a brace on one foot and used a cane. The patient stated that he does not have much endurance but that he does still drive a tractor. Dr. D. scheduled him for a revisit and went back to his office to dictate.

At 3:10 he saw a patient of another neurologist in the group for an EMG, a 30-year-old woman suffering from weakness and numbness in her hands. It appeared that the median nerve was pinched at the wrist. After finishing the EMG, Dr. D. talked with the other neurologist about the patient. At 3:35 he began the dictation on her and was done at 3:40. The diagnosis was carpel tunnel syndrome.

At 3:40 Dr. D. was scheduled to do an EMG on a hospitalized patient, of one of the neurosurgeons. Before Dr. D. saw the patient, the neurosurgeon discussed what he was expecting Dr. D. to find. After their talk Dr. D. went upstairs and began to do the EMG. The patient, a woman who appeared to be in her 50's, had been driven to the office from the hospital for this test. She had had an IVP and a myelogram done earlier that day in the hospital. The EMG was finished at 4:15 and Dr. D. went back down to his office. At 4:17 he received a telephone call from a patient. At 4:20 he dictated the EMG findings.

At 4:25 he had a brief conference with another neurologist about a short, easily administered I.Q. test. (They are trying to find a test that can be administered quickly by the secretaries.)

At 4:27 he saw the patient who had been having her hair done. He discussed with her the "abnormality" that showed up on the EEG. Although he thought the deviation from normal findings was not a recent change, he felt that it should not be ignored and strongly suggested hospitalization for further tests. Because things were very busy at work (they were taking inventory) she put off coming to the hospital until February. He felt confident she would return. He finished with her at 4:31.

At 4:32 he began on some administrative tasks, including a phone call to arrange for a patient to come in for a visit on the following day.

At 4:44 he started reading the EEG's that had been requested by other doctors. (This was his week as the EEG consultant). There were four tests to be read which he finished at 5:10. Then he left the office to go back to the hospital.

At 5:20 he arrived at the hospital and began working on administrative tasks, e.g., delivering charts on patients he was admitting to the appropriate person in the hospital. It also was Dr. D.'s responsibility this week to read EEG's at the hospital as well as at the office. In the hospital office he read 15 EEG's that had been done on six patients and dictated his impressions. He stated that there were a lot of trauma EEG's because of the four neurosurgeons on staff.

At 6:15 the pediatric neurologist for the group came in for a consultation. He left at 6:21. Dr. D. finished up the EEG's and at 6:24 took the records and the dictation to the medical records office. At 6:25 he reviewed the charts of the patients on his floor and by 6:33 he was done.

Dr. D. was going to go home to have a quick supper in order to be back at the hospital at 7:30 for a meeting.

Second Day

Dr. D. picked me up at the motel at 8:20 to go to the hospital. At 8:40 we went to a meeting of the stroke team. This team consists of staff members from occupational therapy, the chaplain's office, social service and nursing, essentially the people who are directly concerned with the care of stroke patients. Dr. D. feels it is a very good team. A neurologist from his group is in charge of their meetings, another responsibility which is rotated. We left the meeting at 8:57.

At nine o'clock we began hospital rounds with the chart cart, the nurse and the intern. The first patient seen was a 30 year old male brain tumor suspect. Dr. D. requested that he be allowed to talk with this patient alone. He finished at 9:07.

(This private chat was partly in response to complaints from the nursing staff. The man tended to demand a good deal of attention and, while he was uncomfortable, the nurses found it annoying to have to go to him so often when other patients were in need of attention, too.)

At 9:12 (after five lost minutes) we went to the 82 year old stroke patient we had seen the day before. While the doctor was talking with the patient's daughters, the patient opened his eyes and looked at me, wrinkling his nose and flirting.

At 9:16 we went to read the sleep EEG done on a 56-year-old man who suffered from nocturnal convulsions. Dr. D. talked to the patient till 9:25.

We then went upstairs to the rehabilitation floor and watched a patient walk.

At 9:45 we left the hospital and Dr. D. drove me around, showing me the town, the shopping center and the college campus.

At 10:30 we arrived at the office, where Dr. D. met with his secretary to give a report on the hospital patients. Then he set up a meeting and carried out other administrative tasks.

At 11:10 he saw his first office patient for the day, a 22-year-old man with an eye problem who was referred by an ophthalmologist. As soon as the interview began, Dr. D. was interrupted by a phone call on the beeper system. At 11:15 he returned to the patient. This young man was a fourth year student at the state university majoring in recreation. Five years ago he was working on a building and "went blind in his left eye for about three to four minutes." It happened again in October after he had been studying a great deal. This time his vision had gotten hazy. At 11:27 Dr. D. went to his office while the patient was undressing, to dictate until 11:32. He went back to the examining room and examined the patient till 11:40 and talked with the patient until 11:45. He discussed his findings with him but did not come up with a diagnosis. He returned to his office and dictated until 11:48.

At 11:48 he resumed his administrative tasks. At 11:50 we went to the country club with his wife for lunch. We returned to the office at 1:10. At 1:15 he saw a 54-year-old man complaining of weakness in his left leg who had been referred by a general practitioner. The patient was once a heavy equipment operator but is now a guard. He reported hurting his leg for the first time 29 years ago in the Army, when he fell during an air raid while they "scrammed" on the beachhead in France. He saw a doctor at that time who said there were no broken bones. When he was discharged from the Army, no problem was found. About five years ago his leg seemed without strength and felt cold, most noticeably in his foot. He said it was more bothersome in the evening. When he gets up from a chair the leg cramps and "wants to pull up."

(Dr. D. was interrupted at this time for three minutes in order to talk to the wife of a patient in the hospital.)

The patient then stated that it had gotten worse over the last five years, particularly in the last couple of years; however, "she's holding her own." He feels that drinking and cigarette smoking make it worse. The pulling sensation is across his back and down the leg. He also had headaches, sometimes severe, sometimes mild. He has allergies as well. In response to questioning he stated that he is allergic to "about everything there is." To questions about passing out he answered, "Once it seemed like a cloud went over the sun." He takes pills for an ulcer, high blood pressure and allergies. At 1:45 Dr. D. began the examination which lasted until 2 p.m. He requested that the secretary escort the patient to the EMG room.

He then returned to his office and dictated until 2:07. From 2:07 until 2:20 Dr. D. had a private discussion (at his request) with a female patient. He said it was a recheck examination.

He then spent two minutes with a patient from the day before, the one with the arm problem who was to be admitted to the hospital.

At 2:25 he went up to the EMG room, did the EMG and finished at 2:43. He then returned downstairs to his office and dictated until 2:46, when he received a phone call from a chiropractor referring a patient complaining of left arm and shoulder pain. He scheduled the patient for an appointment.

At 2:53 he went back into the examining room and discussed the findings of the examination and EMG with the patient and his daughter. The patient agreed to be hospitalized for further tests. By three o'clock Dr. D. had completed his dictation and his hospital orders.

He spoke briefly with the intern at 3:03, found out that there were no beds available at the hospital and that patients would have to wait till the following day to be admitted.

At 3:04 he saw a 32-year-old man with convulsions. At one time he had had total loss of vision in his left visual field. It has been four years since he had been examined. In the last year he had had 15 "mild to moderate" seizures, no falling down, "the same kind as he had had before." At 3:16 Dr. D. finished with the examination. Dr. D. emphasized that the patient should come in for rechecks a little more frequently than once every four years. He then went back to his office and dictated until 3:20. Dr. D. took ten minutes out from his schedule to take me for a tour of the building.

At 3:30 Dr. D. started preparing for his next patient, a 17-year-old male epileptic. He reviewed both the past EEG (done when the boy was 13) and the current EEG and dictated his impressions of the two. He then went to see the boy and his parents. The history indicated that during the first year of diagnosed epilepsy the boy had had six seizures. These were always during the night or in the morning before he woke up. He was sharing a room with his brother but now has his own room. His parents used to be alerted about the seizures by his brother but now have no way of knowing about all of them. The boy is never aware of experiencing these nocturnal seizures. He is taking a vocational program at school and his mother thinks that the medicine he's taking has slowed him down intellectually. He is in good physical shape and his health is "o.k." The patient's father reported that the patient can operate a snowmobile but can't play catch. Dr. D. briefly examined the patient and, because the boy was still having seizures, increased the daily dosage of phenobarbital. Another reason the dosage was increased is that the boy is now physically considerably larger than he was four years ago when the original prescription was given to help control the seizures. He asked the parents to be sure the patient comes in for an examination every two years.

He finished with the patient at 3:50, at which time he received a call from the hospital. They informed him that there was no room for the patient he sent over. At 3:51 he started dictating about the boy and finished at 3:52.

At 3:52 he saw a 59-year-old woman who has had headaches since 1969. She had improved after her visit to him in September (four months earlier) but the headaches had become worse about a month ago. Usually, when a headache starts at the back of her neck, she applies heat to the area. After discussion, Dr. D. recommended that she use an ice bag instead and that she go to physical therapy for exercises. She suggested that she might feel better if she went to Arizona for the sun and Dr. D. agreed. Her diagnosis is muscle contraction headaches. He was finished with the patient and the dictation at 4:06.

At 4:06 he signed a few letters and did some administrative tasks. At 4:15 he left for the hospital.

At 4:25 he stopped at the medical records area in the hospital and left the charts on which he had dictated and the chart on the patient who was to be admitted that day. He also signed his typed dictation.

At 4:32 he went to the office to read EEG's and dictated his findings, finishing at 4:43. He then dictated a discharge summary until 4:46.

At 4:50 Dr. D. started rounds with the intern, nurse and rolling chart cart. He went first to see the patient who had had the sleep EEG and who had just had a lumbar puncture. All the tests were found to be negative and he told the patient that he might possibly be discharged the following day.

One minute later he went to see the 82-year-old stroke patient. He reviewed the chart and decided that a cardiac consultation was necessary. He talked with another physician briefly and then examined the patient. This took eight minutes.

He then spent just enough time to say "hello, how are you?" to the man he had watched walking in physical therapy earlier in the morning and then went on to the woman with the weakness in her arm who had been admitted to the hospital the day before.

It was necessary to talk to the neurosurgeon who was going to perform the tests on this patient. Dr. D. called the office to speak with the neurosurgeon, held on for five minutes and, after no response, hung up.

At 5:10 he saw the brain tumor suspect who had been vomiting earlier but who was now determined to get his spaghetti down!

At 5:15 he saw a 65-year-old man with paresis of the left leg. Dr. D. said it was possibly multiple sclerosis or ten other things. He talked with the man for a couple of minutes and left orders for the neurosurgeon to do a consultation.

At 5:26 he saw a patient who had an obstructed carotid artery.

At 5:27 he visited a 65-year-old man with headaches. He gave orders for tests to be done by the intern and then went downstairs to review the x-rays and brain scan that had been done on the patient. After reviewing them he went back to see the patient at 5:35. He was done at 5:41.

At that time there was a phone call which he handled in one minute.

At 5:43 he was ready to leave. There was a short consultation with the neurosurgeon, after which Dr. D. was done for the day and went home.

Fee-for-Service Multi-Specialty Group Practice

The Clinic is a large group practice of medical specialists. Policy is determined by a Board of Governors of eight physicians and two administrators; the head of the Board is a physician. Essentially, the physicians hire administrators who are directed by a physician. Individual specialists run their own affairs within the general policy. Dr. E. (visited January 18 & 19, 1973) considers the administration of the Clinic very good.

The neurology service at the Clinic is divided into five sections (four adult and one pediatric section) and a speech pathology section and an EEG and EMG laboratory. There is a total of 32 staff neurologists. There are six staff neurosurgeons and four neuroradiologists. (All staff doctors wear suits, not white coats.) The department provides neurological training for ten to 15 medical students a year in a clinical clerkship which lasts from one to three months. There are about 25 interns at the Clinic but Dr. E. is not sure how many rotate through neurology. There are six neurology residents per year accepted for a three-year program and one or two pediatric neurology residents appointed each year for three years. This makes a total of approximately 18 adult neurology residents and 3–6 pediatric neurology residents. More than 100 medical and neurosurgery residents rotate through neurology each year.

Other specialists available to the neurologist, in addition to the neurosurgeons, pediatric neurologists and neuroradiologists, are two speech pathologists and their residents, three full-time and two part-time staff running the electroencephalography lab (10,497 EEG's are done a year) and one full-time and two part-time people in the clinical EMG department.

The Clinic provides highly specialized medicine with a rigid division of labor observable at all levels of operation. This carries over to the administration of the neurology department. For example, with respect to patient coverage, a neurologist is on either hospital service or clinic service. The physician on hospital service has no clinic responsibilities but is expected to cover one of the five hospital services seven days a week, 24 hours a day, for the duration of his assignment. (This is a rotating responsibility, with each neurologist serving two or three times a year.) Dr. E. told me that on the hospital service "sometimes you finish at noon, sometimes you're done at 6 p.m."

There are five routes that a patient may take to see a neurologist at the Clinic:

1. A patient may be referred to the department or to a specific neurologist by his family physician.
2. A patient may call directly and request an appointment.
3. Another service within the Clinic may refer a patient to the department.
4. A physician from another service may request an "off the floor" visit by a neurologist.
5. A patient may return for a follow-up visit.

Patients coming by the first two routes are called "direct registration," i.e., the patient has come directly to the neurology clinic without going through the medical service. For these patients the nurse will take the blood pressure and for women patients a pap smear. Patients in this group usually have to wait six weeks for an appointment.

An "off the floor" case occurs when a physician on another service finds that the patient he is examining has neurological symptoms which he believes will require only 20 minutes of the neurologist's time. The physician calls the neurology department while the patient waits in the examining room. A neurologist sees the patient and immediately gives his impressions to the requesting physician, who then continues with the patient. According to Dr. E. most physicians use this service appropriately. Occasionally a requesting physician does not understand the service and may abuse it by calling for a neurologist to see the patient "off the floor" when in fact the patient should have been referred to the neurology service for a more complete examination.

A follow-up patient has been seen previously by the neurology department and either was instructed to return or now wishes to be seen again.

A specially trained R.N. takes histories on some new patients. She has been with the neurology department for about five months and, according to Dr. E., does an excellent job. He feels that this practice halves the time a physician must spend with the patient.

Interns and residents work up patients also, before that are seen by a staff consultant. The medical students serving their clinical clerkship also take histories and do a preliminary examination on those they or one of the staff think are interesting cases. The medical students present their impressions verbally to the neurologist before the neurologist sees the patient. Then they both examine the patient.

Doctors are paged by a beeper system for phone calls. The doctor immediately dials his code number, which hooks him up to the call. Dr. E. does not like this system because the calls are not screened.

Each examining room is equipped with an x-ray viewer, a small dressing room with a curtain, and examining table with a step at the proper height to check the pelvic girdle and thigh muscles, a couch, a desk and chairs, a sink, a blood pressure cuff on the wall and a light for examining the eyes. This light is mounted on the wall next to the examining table, with a switch box which controls the overhead light as well. Thus the doctor does not have to walk across the room to turn off the light before he examines the optic fundi of the patient. The offices are set up for maximum efficiency without any sacrifice of the patient's comfort. The patient sits on the couch, talks to the doctor, is asked to go into the dressing room and undress to his underpants and put on a gown. While he is undressing, the doctor can write in the chart or continue talking to the patient.

Dr. E. described his weekly schedule of meetings: Monday morning, meeting with heads of sections and chairman of the Department of Neurology; Wednesday morning, clinical conference from 7:30 to 8:30; Monday noon, clinical conference; Thursday noon, epilepsy meeting; Friday noon, departmental human investigation meeting (this week there was a competing meeting at this same time).

Dr. E., a native of New York City, received his B.A. degree at New York University and then went on for his M.A. and M.D. at George Washington University, Washington, D.C. He served his internship in New York City.

He completed a year of medical residency and then took a psychiatric residency followed by a neurology residency, which he completed in 1953. At that time he went to N.I.M.H. where he worked as a chief of the clinical science lab until 1955. In 1955 he was asked to join the Clinic, which he did. Dr. E. was board certified in psychiatry and neurology.

Dr. E. likes the community, stating it has a good theater and symphony. He and his wife enjoy their ski cabin, which is not too far away. He finds the Clinic "a nice way to practice medicine." "The Clinic tries to take off your shoulders everything except what you're professionally supposed to do." He said the physician himself determines whether he does a minimum, medium or maximum examination. Cost and the patient's ability to pay are not factors. The patient population served by the 400 staff members and 500 residents is primarily middle class. Few very poor patients are seen and only rarely a "ghetto" patient.

While I was there, Mr. M. was the medical clerk. His clerkship was a two-month elective. Mr. M. is a medical student at an eastern university and plans to do his internship and residency in neurosurgery there. He feels that this university has topnotch clinical neurologists but that they are not necessarily good teachers. He feels one is easily attracted to his field by the attitude of the professionals around you. Mr. M. came to neurosurgery "through neuroanatomy and music." He had been at the Clinic for almost two months. His reponsibility is to work up patients and then stay with Dr. E. while he does the examination; Dr. E. is thus teaching him how to do a neurological examination.

First Day

At 7:30 a.m. I met Dr. E. at his office. It is his usual practice to dictate, sign letters and carry out administrative tasks between 7:30 and 8:30.

The first patient this morning was an "off the floor" case. We went from the eighth floor to the underground passageway and walked to the Acute Illness Clinic to see a 55-year-old woman. She was experiencing weakness on one side of her face. The patient, who cares for her 90-year-old father while her sister works, stated that the weakness started four days earlier. She said she turned her head quickly and had pain by her ears. Later, when she went for a drink of water and couldn't swallow it, she looked in the mirror and saw that one side of her face was somewhat droopy. Now, Dr. E. observed, she is a little puffy around one side of the face. She experienced no change in taste and had no trouble with hearing.

At 8:43 Dr. E. asked the patient to remove her shoes and stockings and examined her until 8:53 and then asked the patient to get dressed. He talked with the patient, ordered an x-ray and wrote his findings in the chart. The diagnosis was Bell's palsy. He left to go back to the building his office is in at 8:58.

At 9:04 he picked up the chart on a 73-year-old woman from California who had come to the Clinic first in 1934 for an appendectomy. The doctor who saw her then diagnosed her as having chronic nervous exhaustion. In 1935 she had her cervix cauterized and has not been back since then. Current complaints are that she is cantankerous and increasingly difficult to get along with, has progressive difficulty in walking and has had ptosis of the eyelids for the last four years. Her son died late last spring and she feels her daughter, her remaining child, does not care for her. Her internist in Los Angeles suggested that she go to U.C.L.A. to get an EMG because he suspected a muscle disease. However, the patient preferred to return to the Clinic, accompanied by her daughter. The internist in Los Angeles had diagnosed mild dementia. He had also written that the weakness started in February of 1972. Dr. E. said that by the time you read the history you should know what the patient has. His tentative diagnosis, before seeing the patient, was polymyositis. She will probably need an EMG and a muscle biopsy to confirm this diagnosis.

At 9:17 he started towards the room where the patient was waiting. He was interrupted briefly by a phone call regarding the Bell's palsy patient. After the phone call, Dr. E. talked to the patient about her symptoms and at 9:24 he asked her to undress. While she was getting undressed, he asked her why she chose the Clinic over U.C.L.A. The woman said she though the Clinic might find the trouble sooner.

He started the examination at 9:26 and finished it at 9:55. He called the doctor who would perform the muscle biopsy. During the few minutes it took to locate this doctor, Dr. E. wrote his findings in the chart. At ten o'clock the other doctor arrived and Dr. E. left the room.

At 10:08 he picked up the chart on a 39-year-old man. The patient, who works on a farm during the day and cooks at a restaurant at night, is married and has three children. His chief complaint is neck pain which he has had off and on for the last 15 years. Five years ago the pain began lasting longer periods. He described the pain as being like a sunburn or a raw sore. It becomes sharp if he puts his hands over his head. There is no pain from the neck down, no history of trauma.

Dr. E. called the patient into the examining room and started talking to him. The patient works 12 to 14 hours a day and likes it. He stated he was brought up on hard work and would probably die on hard work. He works because he needs the money. When asked what he thought he had, he said it did cross his mind that he might have cancer because his father died of cancer. After Dr. E. finished the examination, he told the man he had a choice—he could have pain in his neck or he could have money. The patient said he would choose the money. Dr. E. then recommended physical therapy with heat and massage. He reassured the patient several times that he really had no serious disease, that it was tension probably brought on by his working very hard. He finished at 10:37. At this point we had a six minute break.

At 10:43 Dr. E. saw a 60-year-old man also from Illinois who had a tremor in his hand. His tremor is possibly of six or eight years' duration and occurs when he is using his hand, not when it is relaxed. It bothers him primarily when he is writing, putting on his tie or belt, or drinking. Questions elicited the facts that his father died when he was eight months old and his mother died of "general degradation." At 10:47 Dr. E. asked the patient to undress and put on a gown. While the man was changing, Dr. E. continued asking questions. The patient said that drinking alcohol does not make any difference to the tremor.

Dr. E. was interrupted by a one-minute call from the physician who will do the muscle biopsy on the woman from California.

Dr. E. was examining the patient when the patient said his arm "wanted to straighten out." Dr. E. sat for three minutes watching the arm doing its thing. The onset of this symptom, in which the outer muscle of the upper arm appears to have a spasm causing the arm to straighten, was six to eight months ago. The patient also mentioned he had pain across his neck. He said it was not "a fierce or agonizing" pain and that it only appears when he is relaxed or writing. Dr. E. told him that he had transmission (switchboard) problems near the brain causing the arm and hand problem and that it was not related to the neck pain. He put through a call to a neurologist who is an expert on movement disorders and another to a current Clinic resident. The resident was not available but the other physician said he would be over in 20 minutes. Dr. E. wrote up his preliminary impressions in the chart and then continued the examination. Dr. E. gave the patient a choice; would he rather be rid of the tremor or the involuntary straightening movement? There was no answer and Dr. E. was interrupted by a call from another patient. Dr. E. diagnosed the patient as having a movement tremor and involuntary movement disorder of unknown etiology.

He left at 11:27 to talk to his next patient, a 24-year-old woman with cerebral palsy. She had come in to discuss some back discomfort she was having and the doctor felt that there was no apparent need for a myelogram or surgery at this time, that physical therapy would take care of whatever she has.

At 11:34 Dr. E. stopped to discuss with a medical student another patient, a 31 year old woman on whom the student had taken the history. He said the history taking had required two hours. The patient has had two lumbar laminectomies, one in December, 1971 and one in September, 1972. She has had fibroid tumors removed and a hysterectomy. Both of her parents had back problems; her father is deceased. The patient had a car accident in 1965. At one time she had been a ballroom dance instructor. Her current weight is 197 pounds.

At 11:44 Dr. E. started his examination of this woman. He finished the examination at noon and wrote up his findings in the chart. Before Dr. E. could reach a definite diagnosis, it was necessary for her to complete the testing and examinations ordered by other services at the Clinic. At 12:13 we left for an elipepsy meeting. (We had lunch during the epilepsy meeting.)

At 1:35, ten minutes after we left the meeting, we were seeing another "off the floor" case, a 36 year old high school teacher from Minnesota with a convulsive disorder. In 1965 he had one seizure and then another a month later. He had no other siezures until one in 1966 when he forgot his medication. He then had a seizure last Saturday. He said they are not grand mal seizures but he does lose consciousness and fall to the floor. (Dr. E. was interrupted by a phone call for about one minute.) The teacher has four or five headaches a week, lasting usually about three-fourths of a day. He has one now on top of his head. The headaches are usually frontal, on one side of his head or the other.

At 1:46 Dr. E. asked him to undress and put on a gown. He then called for a report on the EEG done on this patient in the morning. While waiting for the report he put his patient through the routine exercises used in the examination. He got the EEG report at 1:50 and looked at the skull films. The man mentioned that he had been in an automobile accident in 1956 which had resulted in a head injury. The man also mentioned that he had noise inside his head. Dr. E. asked him to describe it and he said it was "about 1,000 decibels."

Dr. E. finished the examination at 2 p.m. He said the x-rays showed a pineal displacement. He ordered a brain scan, saying he would be looking for a scar, A-V malformation or growth. The patient was scheduled for a brain scan at 8:00 a.m. the following morning. Dr. E. would see him in the afternoon. He left the patient at 2:07 and arrived in neurology at 2:10.

At 2:20 he saw a 69-year-old man from Illinois who was complaining of weakness, hypertensive heart disease and diabetes (for which he has been on 20 units of NPH insulin a day for the past ten years). The man said he had come here from Poland in 1925. At first he was a farmer and then a clothes cutter. In the fall of 1971 his varicose veins were injected. (A phone call regarding medicine for another patient took 30 seconds.) The weakness started in his feet in early September, 1972 and then his legs became weak. He couldn't get up from a squat position and he found difficulty going up stairs because his legs "would buckle." The left leg was worse than the right and the weakness prevents him from walking. The weakness stops when he rests. He can hobble about 15 to 20 yards at most. His legs and feet cramp if they get cold. At 2:27 Dr. E. left the room to see another patient while the man was getting undressed.

The next patient was a 61-year-old woman from Ohio who had cerebellar degeneration. She was back to see if there were any new developments. Dr. E. checked to see which neurosurgeon was free. He talked to her and her family about doing a diagnostic test to see if she "might have something they can do something for."

At 2:34 he left the woman, put out a call for a neurosurgeon and started down the hallway towards the undressing patient when the movement disorder specialist arrived to see the patient with the movement tremor. Dr. E. was then interrupted by an eight minute phone call from a physician in Texas regarding a patient. Dr. E. left the room to arrange an appointment for this patient. At 2:47 he was back with the movement disorder specialist to see the tremor patient and fill out a form requesting a test. He finished at 2:55 and then there was a brief conversation regarding the ex-dance teacher. Dr. E. went back to see the older man at 2:58. Then he realized he had misplaced his black doctor's bag and looked for it; he found it under a chair in the Staff Room.

At 3:07 he started the examination of the man, apologizing for the interruptions. He was done with him at 3:25. The diagnosis was questionable polymyositis and shoulder disease. (The man had complained of pain in his shoulder.) He wrote out an order and his impressions in the chart while the patient was getting dressed. At 3:30 he left to discuss the cerebellar degeneration with the neurosurgeon and to introduce the neurosurgeon to the patient and her family. That took about two minutes, after which he returned to finish writing his findings in the chart; he was interrupted for a brief chat with the neurosurgeon regarding the patient. He took the chart out to the desk and at 3:40 was back with the patient with cerebellar degeneration, to re-enforce what the neurosurgeon had said. He was out at the desk for the next patient at 3:47.

At 3:52 Dr. E. saw a 42-year-old woman from Canada. She had been worked up by the medical student. Her history started when she had pulled the starting rope on a lawnmower and hurt her back in May, 1972. She was now suffering numbness in her left leg and upper hip. In response to questions, she reported that it started at the knee, that sometimes she had tingling in her hands and that she was here to find out what was wrong with her. Dr. E. noted that her history showed "hepatitis" and eye difficulty. Dr. E. said that from the history, the patient "seemed to be a mess." At 4:02 he started to talk with the patient, who said her "hepatitis" was diagnosed after a symptom of dizziness. She had had trouble walking which lasted for a year. A year and a half after that, she had trouble with her eye, double vision when she looked to the right. Four years ago she was diagnosed as having "Bell's palsy." Her right eye had failed to move laterally to the right and her mouth drooped a little on the right side. Dr. E. said this was right lateral rectus palsy and probably some right facial weakness. He examined the patient with the medical student assisting him. (At 4:19 he received a phone call and made a phone call.)

After the examination Dr. E. told the woman he was convinced she had multiple sclerosis. He could do a lumbar puncture to confirm this diagnosis for her if she wanted; however, he had all the information he needed to make the diagnosis. He discussed with the student the basis for making the diagnosis and finished the discussion and write-up in the chart at 4:53.

He went back to his office and while he was catching up on his administrative tasks another physician walked in for a brief consultation regarding a 37 year old woman who had "episodes." He finished the administrative tasks at 5:28 and left the Clinic to go to a nearby hospital. At 5:40 he arrived at the hospital and visited his patient, a 56 year old man from Indiana with Wilson's disease. The patient had volunteered to be part of Dr. E.'s research on Wilson's disease and he was getting free treatment for volunteering to be a research patient. Dr. E. finished at 5:50 and left the hospital to go home.

Second Day

Dr. E. started work at 7:30 the following morning. A speech pathologist came over and talked to him about funding. They finished talking at 8:55, at which point a neurologist in the section asked for both their opinions regarding a patient in his office. Dr. E. finished in there at 8:58.

At 8:59 he saw the woman with multiple sclerosis he had seen yesterday. The woman decided she did not want a lumbar puncture but did have a lot of questions: can she take Elavil? yes; can she have a drink? yes; can she eat normally? yes; is the pain in her back from multiple sclerosis? could be; why is numbness worse when she lies down? no reason; when she is nervous why is it worse? nervousness makes any symptom worse; are the poor sleep habits from multiple sclerosis? no, that's from nervousness; why has she had bowel problems like diarrhea? part of multiple sclerosis; what about her eyesight? her eyesight is all right, there was damage but it is minimal and very rarely does it produce blindness; did the hepatitis come from multiple sclerosis? don't know; why does she have a sharp pain in her arm? due to either multiple sclerosis or nervousness; sex life? not affected by multiple sclerosis; are there symptoms with remission? yes, she only has a penny's worth of multiple sclerosis. She left and Dr. E. finished writing in the chart at 9:10.

At 9:10 he started to see a woman he had seen a few days earlier but learned that her EMG report was not yet back so he picked up another patient's chart. At 9:11 he saw a 58-year-old physician, an ENT specialist from a small town who has had a temporal lobe seizure disorder since 1965. Dr. E. suspects a slow growing tumor. The patient has occasionally had seizures while operating; Dr. E. told him he should not perform surgery, pointing out that his malpractice insurance would be "out the window" if he had a seizure while he was operating. Dr. E. reviewed the brain scan, which was negative, as was the head x-ray; the EEG showed no change. He started talking to the patient, who revealed that he had had two major spells last year plus a few minor ones. Dr. E. changed his medication from 300 milligrams of Dilantin a day to 400; he is to take 200 in the morning and 200 at night. (The patient and his wife have been trying to finish up at the Clinic early in the day because there are no planes to Nebraska on Saturday or Sunday.)

Dr. E. was interrupted by a two or three minute phone call from a patient and then went out and talked briefly to the woman at the appointment desk.

At 9:40 he started with a 60 year old woman who had been here two days earlier with a complaint of weakness. Dr. E. had ordered an EMG; they suspect thyroid trouble (myxedema) since there is no sign of primary muscle disease. He would have to check the reflexes in her ankles. He tapped the muscle in her upper arm and it popped back up (myoedema). He put in a call for the resident to come and see this popping muscle. At 9:50 he finished and went out to the desk, getting ready to go "off the floor." First he talked again with another neurologist about the patient Dr. E. and a speech pathologist had been consulted on earlier in the morning.

At 9:53 he left for the "off the floor" case. He talked with the physician who had requested the consultation about the patient, a 39-year-old man.

The patient, a telephone company supervisor who was complaining of back pain, used to race motorcycles. He had been run over by one, which necessitated 30 stitches in his "tail end." The accident, which occurred in 1951 or 1952, had apparently caused no other problems. He's had back trouble for quite a few years and has been sleeping on a bed board. In November, 1971 he was playing volley ball and couldn't straighten up because of the lumbar pain. His left leg bothers him at times but there is no sharp pain running down the leg.

As is his method, Dr. E. asked the patient if he would rather have the pain or a big back operation. The man didn't seem to be sure what back surgery involved so Dr. E. explained it to him and then asked him to get undressed so he could examine him.

At 10:10 he finished the examination, finding no neurologic deficits. He gave the patient the option of having surgery (because the x-ray showed slippage) or getting rid of the pain without surgery by giving up bowling, not using his back and "getting some weight off." The patient elected not to have surgery. Dr. E. wrote his findings in the chart, talked to the patient and finished at 10:16.

At 10:25 he was back on the neurology service for his next patient, the 24 year old woman with cerebral palsy whom he had seen yesterday. He looked at her chart and said that they would continue physical therapy. She will have to consider giving up nursing for work where she will not have to use her back so much.

At 10:45 he talked with and examined a 36 year old woman from Minnesota who was referred from Medicine. She has headaches which started 11 years ago, occurring with menses only. The patient left at 11:05; Dr. E. finished and left too, taking the patient's chart out to the desk.

At 11:08 he had a consultation with a neurolgist in his section.

At 11:14 he was teaching Mr. M. how to do the straight leg raising test.

At 11:17 he had a phone call which lasted for one minute. Next he saw a 30-year-old man from Illinois who had had a seizure disorder from age one or two until age 11. At that time he had had two or three seizures a month. He was told that during these episodes the right side of his face would draw, twitch and feel numb; there was no report of shaking or passing out. Afterwards he would sleep for ten to 12 hours. No medication had been prescribed for these. In February, 1971 he started having spells again; he descirbed them as being like hot flashes. During them he feels tingly and funny all over and, according to his wife, he swallows frequently. (His wife states he does not lose consciousness.)

At 11:24 Dr. E. was interrupted by a neurosurgeon for a brief consult.

At 11:27 he went back to the patient, who said the spells last one minute or so. The patient is taking phenobarbital and Dilantin, combined, four times a day. Dr. E. started to look for this medication in the PDR. The patient is also taking four Valium a day. In February, 1972 he had a bad spell, described as a generalized convulsion, which occurred in a shopping center. He was hospitalized and remained unconscious for two days. The patient had had an EEG this morning and, while he was undressing, Dr. E. called the EEG lab to see if it had been read yet. It had not. During the examination the patient said he had been very nervous for the last three years. He also said that his son had had spells when he was an infant, before his first birthday. His son would cry and hold his breath and almost pass out. He was diagnosed as epileptic; however, he is all right now. (The boy is now eight.) to a question, he responded that one medication prescribed for him made him "go out of his head" and act crazy.

At 11:58 Dr. E. finished with the examination and sent the patient to get a blood sample. He told the patient that he would see him again at 1:30. The patient was anxious to finish up that day and return home.

At noon Dr. E. phoned another neurologist to request a consult on this patient. At 12:05 he left for lunch and a Research Committee meeting.

At 1:35 he was back and had a phone call.

At 1:40 he saw a woman he had seen yesterday. The muscle biopsy had been completed and the final diagnosis was probable muscular dystrophy. At 1:42 he began talking to the patient and her daughter. He said they could consider treating her with steroids but, if it was dystrophy, the steroids wouldn't help. The history was more consistent with polymyositis, however, Further discussion with the daughter revealed that the weakness began about six years ago. The patient kept claiming that it began recently. If the weakness was of longer duration, the diagnosis of dystrophy was accurate. (Dr. E. takes time to answer all the questions fully while he is writing up the chart.)

The patient needed help with the dressing on the muscle biopsy wound and he called the appropriate department to do this. The patient and her daughter immediately went there. Dr. E. finished with this case at 2:03. He went out to the desk, wrote up the diagnosis on the card and picked up the next folder.

He called regarding the EEG for the man he had seen before lunch; it had not yet been read.

At 2:10 he saw a 41 year old woman who suffers from headaches and dilated pupils. Earlier in the week he had ordered an angiogram, which was negative. All the tests—the echo, x-rays and brain scan—were normal except the EEG. He talked with her, gave her a prescription, finished at 2:20 and went back to the desk to write.

At 2:21 he picked up the chart on a 68-year-old man. Three weeks ago this man began having trouble walking, using his right hand and speaking clearly. From his blood test it was apparent that he had drug toxicity and that part of his current problem was Dilantin intoxication. The patient has a seizure disorder. On an average, he had one or two siezures a month; his most recent was in the first part of December. During these seizures, he loses consciousness for a minute or so. While talking with the patient and his wife, Dr. E. said one of the things he would have to rule out is the possibility that he had had a small stroke. The man was obviously very intoxicated. Dr. E. left him to undress at 2:40 and went to another room where he called the EEG lab again. He was called back and said that he was told the EEG was normal.

At 2:44 he went to talk to the patient from Illinois. The EEG was normal as have been the four EEG's done in the last two years. Dr. E. suggested that he see a psychiatrist. Dr. E. feels that the patient's "seizures" are psychogenic and that his MMPI showed pathology. Dr. E. said it may not be a seizure disorder but a nervous reaction and that it would be helpful if his wife could come along next time to describe how he looks. Dr. E. suggested that he come back at a later date and finished with the patient at 2:53.

He then returned to the "drunk" patient at 2:55. It was very difficult for the wife to help the patient because he is a large man and very unsteady. At 3:02 Dr. E. was interrupted by the speech pathologist regarding research funding. At 3:10 he checked on the availability of a hospital bed for this intoxicated patient. He then continued with the examination, helped him get dressed and finished at 3:25.

At 3:30 he saw a 28-year-old man who had pseudarthrosis for which he had had a fusion. Dr. E. talked with Mr. M. about the patient and then went to the patient. On questioning, the patient revealed he had recently helped his mother move a washing machine. Dr. E. examined the patient, talked with him, looked at the x-ray and discussed his findings. He told the patient he should not be doing any of "that stuff" (requiring use of his back). He finished at 3:55.

Next he saw the patient with the pineal displacement, who had come today with his wife. Dr. E. told them that the brain scan was negative and that he should be hospitalized for further tests. He finished at 3:59 and went "off the floor" to see a 53-year-old woman from a town in Indiana. Her presenting complaints are leg pain and back ache. She is a personnnel manager, a desk job. In 1965 she had back pain for which surgery was performed. She had had no problems until 1972 when she mowed the lawn. (Dr. E. was interrupted by a patient's call and by a call from a physician regarding the muscular dystrophy lady.) When he examined the patient, he found weakness and sensory nerve root involvement. He therefore called a neurosurgeon to come down. He left the patient at 4:30.

At 4:33 he picked up the next chart, of a 33-year-old man. He said he has been seeing a urologist because he has a "slow stream: and does not empty his bladder completely. He also said he "has gone dead in the south." To a question, he responded that he has no trouble getting an erection; however, the sensation is not the same.

Dr. E. left briefly at 4:40 for a three-minute conference with a neurosurgeon regarding the previous patient.

At 4:43 he was back to see the patient, who said he had had headaches once a month for three or four years. He really came here for his bladder and wouldn't have made the trip just for his headaches. He said he can tell when a headache is coming because a crescent appears and blanks out part of his vision. Then, when that goes away, a headache occurs. He said the headache is located behind the eyes on either the left or right side. The crescent lasts from 15 to 20 minutes and the average duration of the headaches is ten hours. He also stated that he has had a backache for about two years which is exacerbated by bending: he does not feel that this is a big problem, even though, in reply to a question, he stated that he is a miner.

From the results of the MMPI, Dr. E. feels that the patient has had a little conversion reaction and that he is a psychopath. (The patient has been treated for alcoholism.)

Dr. E. was interrupted again by the speech pathologist, still about funding.

At 5 p.m. Dr. E. went back to see the pineal displacement patient who was being hospitalized. He went out to the desk and continued to get things ready for his admission until 5:03.

At 5:04 he went back to the patient with the headache, backache and "dead south." The patient cannot smell anything out of his left nostril as a result of a car wreck in 1963 or 1964. He was in the Navy and the Air Force and has many tattooes. To a question he said it cost $300 to have the smallest one taken off, so they are staying. He was tattooed 17 years ago. He said that he occasionally drank very heavily, always beer. Asked why he quit, he said he had a choice of getting help with not drinking or going to jail. As to how much he drank, he said "a case." Dr. E. finished with the examination at 5:25 and said there was nothing for sure until after the patient has had a cystoscopy.

Dr. E. was done at 5:28 and left the office at 5:32 to go to a nearby hospital. There he would visit his Wilson's disease patient as he had done yesterday and then he would go off skiing for the week-end.

Prepaid Multi-Specialty Group Practice

Dr. F. (visited March 12 & 13, 1973) is a native New Yorker. A graduate of Columbia College and then of the College of Physicians and Surgeons, Columbia University, he interned and returned to Columbia, to the Neurological Institute of New York, for a three-year residency. He then spent a year working under an N.I.H. grant before joining a prepaid group practice. He was board certified in neurology five years later. Among the reasons given by Dr. F. for joining this organization are the opportunity for an interesting and varied clinical practice, the professional stimulation of well trained colleagues and the possibilities of clinical research. He had not wanted a career in private practice and while he would have liked academia, he did not like basic research, the only way of "making it" at a university. His goal therefore was a group which provided him with both professional and intellectual stimulation. He states that this could have been obtained with a small group of neurologists and neurosurgeons, but that there were none with openings at the time he was making his decision and that the group he joined offered him the balance he was looking for. It is university affiliated (He is an associate professor at a nearby, recognized university.), involves him in direct patient care and permits him to conduct clinical research on Bell's palsy and febrile seizures. The pay, he states, is halfway between what is offered in a university and what he might earn in private practice. In discussing other groups, he reported that ten years ago a prepaid group practice in New York had offered him $8,000 while his current group had offered him $17,000.

Dr. F's prepaid group practice is comprised of the hospital and the medical group. The medical group includes physician partners and full-time salaried physicians, the latter becoming partners after a trial period. The hospital is owned and operated on a voluntary, non-profit basis. Patients of the medical group are insured for comprehensive medical care, both ambulatory and in-hospital care, usually through their jobs. (Occasionally, enrollment is opened to individuals or families as direct subscribers.)

At this particular location, Dr. F. is one of six neurologists and five neurosurgeons. The neurology department will soon have a residency program but at this point only medical residents rotate through neurology. Dr. F. states that he works 70 to 80 hours a week; of this, 60 percent is in direct patient care. The rest of his time is divided between teaching (He spends part of one morning at the university on Grand Rounds and one full morning teaching university students.), lecturing, writing papers and reading.

Dr. F. has written a paper which was accepted by the International Congress of Neurology for their meeting to be held in Barcelona in September. When a paper is accepted for presentation at a professional meeting, the employer will pay for the transportation and a three-day stay.

Dr. F.'s office is one of several rooms along a corridor. Each of the neurologists has an office and an examining room. In Dr. F.'s office is a typewriter on which he does some of his own typing. In his examining room are letter size file cabinets and a 3×5 card file. When he reads an article he always writes up a summary on a 3×5 card, thus maintaining his own library. He does his own filing and expressed a wish for a personal secretary.

A patient for Dr. F. is put in the examining room. After the examination, Dr. F. goes to his office, asking the patient to join him there when he has dressed. He talks with the patient in his office and usually dictates as soon as the patient leaves.

Dr. F. describes himself as "hyper" and states that because of this he uses more than one examining room.

First Day

I was to call Dr. F. at 9:30 Monday morning but when I did so he was not yet available. His secretary returned my call and asked me to walk the short distance to his office. I did not begin observing Dr. F.'s day until 10:05, at which time he was fixing a paper cut between his fingers. At 10:00 he saw the first patient (He had seen at least one patient before I arrived), a 13-year-old boy who had been referred by a pediatrician on recommendation of the school psychiatrist, who had seen the youngster because he was slow in school. Talking with the boy's mother, Dr. F. learned that he has always had difficulties with school but that they had increased as the boy moved into the higher grades. He has a younger brother who is quite advanced in school. The mother is divorced and lives with her parents. Asked why was she coming to a neurologist now, the mother stated that the boy needed an examination in order to get into a special class. According to the mother, his behavior is normal and the boy himself volunteered that he was very active in Little League baseball.

The family history revealed nothing; there was a normal pregnancy and delivery and a normal developmental history. In response to a question about possible emotional problems, the mother stated that he is stubborn and that his only real interest is in baseball. He had had one fall when he was a child, which left a large bruise on his head.

Dr. F. then talked to the patient and examined him. The patient was already dressed in a hospital gown. The examination, starting at 10:20 and lasting until 10:23, included a question and answer period with the patient about current events, history, simple arithmetic and analogies.

After the examination Dr. F. asked the mother to come down the hall with him to his office while the child was dressing. He told her that it was his impression that the problems were emotional as well as physical. (He was interrupted by a phone call from the receptionist about a patient who was requesting to be seen today. Dr. F. explained that that would be impossible and that he would have to be worked in at another time.) He suggested to the mother that the patient have an EEG, skull films, blood tests, urine tests and thyroid tests. He also requested that the boy get psychological testing through the school. When the boy arrived, Dr. F. found a book on his shelf and had him read the beginning paragraph or so of "The Three Bears" and then asked him to interpret it. He also drew a diagram of a square on a triangle touching a circle and asked the boy to copy it, which he did quite well.

Dr. F. filled out the forms for the laboratory work and gave the mother a note, written on a prescription pad, reminding her to request psychological testing. He scheduled the boy for a revisit in two months.

After the patient and his mother left the room, Dr. F. picked up his telephone, dialed a number and dictated on a telephone dictation machine which is activated by voice sounds and stops when these cease. He started this at 10:35 but was interrupted by the receptionist who asked if he could work in his 4:20 patient earlier. He finished at 10:38 and then signed correspondence which had been typed up earlier.

At 10:44 a neurologist from the department came to ask Dr. F. a question about the patient he had just seen. This took approximately two minutes.

At 10:46 he picked up the chart for the next patient from a little box outside his office and asked the clerk to put the patient in an examining room. While this was being done, he called one of the secretaries and asked her to find another secretary. The secretary returned his phone call and he asked her if he could do some xerox copying of his own personal material. He was given permission to do so. He then typed out an envelope and mailed something. He continued typing some envelopes.

At 10:50 he went in to see the next patient, a woman in her sixties coming for a revisit. She had had questionable seizures and questionable hyperventilation. She reported that in the period since her last visit she has had no blackouts but can't get rid of the feeling that she's going down in an elevator, "a sickening feeling, it's scary." During these times she breathes very heavily. Dr. F. suggested that she might be hyperventilating and that the breathing may bring on these episodes, rather than the episodes bringing on the heavy breathing. He told her to carry a "baggie" around with her and to breathe into it when an epidsode is coming on. He gave this woman a "dressed examination" (in her street clothes). While Dr. F. was examining her, the woman revealed that she is having "family problems." She has been in the process of institutionalizing her 85-year-old father which, while painful for her, would make life a lot easier than having him continue to live with her and her husband. She also asked Dr. F. questions about her sister-in-law, who is 50 years old and has been on and off "dope," narcotics. At the present time her sister-in-law's husband is dying and the sister-in-law has been making frequent phone calls to the patient and her husband during all hours of the day and night. A few years ago, she and her husband attempted to get psychological treatment for this woman by taking her to a university psychiatric facility. The facility stated treatment could start in a few weeks and that they would see her once a week. The entire family was very upset because no immediate service was given and stronger measures were not being planned. Since this episode, the sister-in-law has refused to go back for any kind of treatment. The problem which the patient faces is that she does not want to leave the phone off the hook because of her father in the nursing home but she is becoming exhausted from having her sleep interrupted. Dr. F. discussed this with her and stated there was little that could be done for the sister-in-law unless she wants some sort of treatment or therapy. He suggested that they be very firm with the sister-in-law.

He scheduled this patient for a revisit in three months and was finished seeing her at 10:56. This time he wrote in the chart rather than dictating and was finished at 11 o'clock. At that time he made a phone call to the administrator's secretary and left a message. He was interrupted by a secretary asking him to read some handwriting on a chart. He then walked down to the floor where the Xerox machine was located, used the machine and got back to his office at 11:10, at which time he started with the next patient. Before going in to see the patient, however, he had a two minute consultation with a neurologist who came in asking a question. Dr. F. referred to a book he has recently published with another neurologist.

The next patient was a 57-year-old man who has Parkinson's disease, here for a revisit. He has been on L-Dopa and Dr. F. talked briefly with him, looked at his wrists and had him hold out his hands and observed that the tremor was barely noticeable. He took the man to his office and wrote out a prescription. He asked the man to schedule a revisit in six or seven weeks. He wrote on the chart and was done at 11:20. At 11:21 he saw a man who had suffered from Bell's palsy two years ago. The man's complaints at this point were that his eye bothers him, tearing a lot, that his face pulls and that his ears are plugged. Dr. F. spent time talking to this man about what could be expected, what the problems were caused by and what he could do about them. He told him that maximal recovery had already occurred. The man asked why Dr. F. had told him to stop going to physical medicine. Dr. F. said that he had done so because the nerve had recovered as much as it would and reiterated that he will never regain full strength in his face. He recommended that the man massage the side of his face so that it will not pull. He also checked his ear and suggested seeing someone in the ENT department regarding ear stuffiness. He should also make sure that he blinks his eye because lack of blinking is the cause of the tearing.

Dr. F. finished with the patient at 11:30 and then went to the allergy clinic for his allergy shots. When he got the injection in one arm he suggested to the nurse that she throw out the needle. At 11:40 he had a private meeting with the clinic administrator which lasted until 12:10.

At 12:10 we went to a luncheon of Kentucky Fried Chicken provided by the drug companies. (They had samples and brochures lined up against the wall.) We were there until 12:45, when he left to go first to the bank and then to the travel agency to arrange for his flight to Barcelona.

At 1:32 we joined the neurologists from the two neighboring groups for Grand Rounds with a visiting neurologist who was examining a patient when we arrived. The group moved to the hallway to disucss his findings and impressions regarding the patient. At 1:50 he went to the next floor to see another patient, following essentially the same routine. This was a patient of Dr. F.'s, a 22-year-old woman with a diagnosis of questionable intracranial seeding of a cervical cord glioma. In addition to discussing the patient, the visiting neurologist also told some stories and was a delightful and charming man. Dr. F. finished at 2:40. By then he was 45 minutes behind his schedule.

From 2:45 to 2:50 Dr. F. rechecked a seizure disorder patient, a man in his late sixties. He also spent a couple of minutes with a staff member who wanted some information regarding her own condition and treatment.

At 2:55 he saw a 60-year-old man who has a diagnosis of probable metastatic cancer and who reported to Dr. F. that he had a spell during which he could not talk for 15 minutes. To close questioning, he stated that there was no speech at all. He has also had a tremendous weight loss. The examination revealed right hemiparesis. Dr. F. ordered a chest x-ray, an EEG, a brain scan and an echoencephalogram. While the man was getting his shoes on, Dr. F. went to his office to wait for him and his wife. When they came, he disucssed why he was going to increase the Dilantin dosage. They needed a refill and the woman said she would have the druggist call him. Dr. F. indicated that he wanted the patient to come back to be checked in six weeks and that if the spells should continue, he should be called sooner. He finished with the patient at 3:05 and then dictated on the telephone for two minutes.

At 3:07 he returned a call regarding the correct title of an article.

At 3:08 he received a three minute phone call from a neurologist regarding "fascinating findings" on a patient.

At 3:11 he saw, on a return visit, a 31 year old woman with scleroderma, transverse myelitis and stroke. She was a very pleasant woman who was here with her husband. She began by saying, "I have a surprise for you. I raised my hand last night and this morning. I kept saying to myself, 'Where's Dr. F.? He should be here to see this.' " At the present time she could not raise it but her husband substantiated her story, saying that she had lifted it six inches. Although in a wheel chair, she states she can now stand on her left leg without the knee buckling. Her right leg is having spasms and Dr. F. indicated that her husband should massage it. The woman said her husband has been very good to her. Dr. F. asked them to schedule another visit.

At 3:14 Dr. F. saw a two and a half year old boy who had had convulsions with fever. (Dr. F. is conducting a research project on febrile convulsion.) Because this was the first time he had seen this patient, he filled out a form about three pages long which includes a family history, information regarding pregnancy and delivery, developmental history and father's occupation. He also examined the patient, using a lollipop to get the child to respond. At 3:25 he asked that the nurse weigh the patient.

He went down the hallway to talk with a woman who had been making a fuss in the waiting room. She wanted the answers to some questions and he quieted her, saying that he could not talk now but that she should call him later in the afternoon when he would discuss her husband's illness with her.

At 3:26 he measured the head and chest of the two and a half year old and at 3:26$^1/_2$ was back in his office reading EEG's that had been dropped off earlier. At 3:30 he was interrupted by a phone call from his wife.

At that point, the child and his mother entered the office and Dr. F. typed out instructions for taking the medication and about what to do if the child has a fever. He filled out the forms for a skull x-ray, EEG and blood tests to be done on the child. He stated that until the boy is six he should see Dr. F. once a year and a pediatrician every four months. By age six most children have grown out of this condition. He finished with the child at 3:45, at which time there was another phone call. After the phone call, he finished with the chart at 3:48. He began reading EEG's but changed his mind and made a phone call. The line was busy and so he went back to reading EEG's.

At 3:51 he saw a referral from a general practitioner, a 45-year-old woman who was complaining of headaches. She said she has had common headaches located in the frontal region. She has pain on both sides of her head when she is nervous. On January 15th of this year she stated she had pressure in her head and felt numb on the left side of her body for about one minute. It happened later in the day again; however, the attack was milder. Upon questioning she revealed that in November she had been walking to her office without looking where she was going and had hit her head on a hard object.

Dr. F. gave her a neurologic examination and asked her to get dressed. He walked down the hallway to his office and at 4:00 called another physician about an appointment. At 4:01 the patient arrived at his office and he noted that an EEG and x-ray had been done. He said all the tests were negative but he would like to try another blood test. He gave her a prescription for Valium and asked that she come back in two months. He will need these additional tests to rule out a seizure disorder or TIA.

AT 4:04 there was a telephone call. At 4:06 there was another phone call, this one to clarify the tests on the last patient. Then he began phone dictation, finishing at 4:10. At 4:10 he had a phone call from an internist in a nearby town regarding a myasthenia gravis case and the use of steroids. He advised that another neurologist from the group, Dr. Smith, should see the patient. They also discussed another patient, finishing the phone call at 4:18, at which time the nurse requested that Dr. F. see a patient who was threatening to go home, a man in his late sixties who has temporal arteritis and is on prednisone. While Dr. F. was examining him, the R.N. interrupted to say a lady who had called in the morning was on the phone and Dr. F. requested that she put the party on hold. He finished with the patient in approximately six minutes and then went to the front desk to check the time of the man's next appointment. At 4:27 he picked up the phone, finishing at 4:30, at which time he read his mail. At 4:45 he left for the hospital, which is next door. At 4:50, before seeing his first hospital patient, he spoke to the ENT physician who had examined the patient's sinuses. The patient was a 38 year old woman with a five day history of weakness on the left side prior to hospitalization. The etiology was obscure—possibly a small infarct from the use of oral contraceptives or an episode of a demyelinating disease. One other possibility was focal encephalitis. The patient was to be discharged tomorrow and followed in the clinic. He talked to the husband about the discharge and the physical therapy to be given on an out-patient basis.

As he was leaving the hospital, he was interrupted by a surgeon who described a woman who had had a mastectomy and was suffering from "burning" across the incision: the surgeon asked Dr. F.'s advice. He spent some time talking with him and then, as we went out, the surgeon followed and said that he was really asking for a formal consultation. Dr. F. said that he should send the patient to a neurosurgeon who might try hypnosis, that this was not a neurologist's problem.

Generally Dr. F.'s group has a neuroradiology conference from five to six on Monday. However, the conference had been cancelled by the neuroradiologists so that there was nothing to do until the 6:30 meeting to be held at another hospital about 20 miles away, where the guest speaker was to be the neurologist who had been on Grand Rounds. Dr. F. and I went there; the meeting finished at a little after nine o'clock.

Second Day

The first patient, who was scheduled for a 9 a.m. appointment, had cancelled it, giving Dr. F. some time to carry out his administrative tasks. He filed cards in his "library" and did some filing in the cabinets in his examining room.

At 9:30 he began making phone calls to the library about references he needed. The rest of his time was spent recording the results of tests on a form, making a phone call to a patient who is in one of his research projects and skimming through a paper to see if it should be filed.

At 9:43 the nurse announced that the second patient was here. At 9:46 he began seeing the man, who was in his early 50's and suffered from attacks of transient cerebral insufficiency. The man, a builder, had had no attacks since his last visit. He was in the middle of having tests, would be getting a brain scan tomorrow and wished to discuss the danger of an angiogram. Dr. F. spent a few minutes answering his questions about the test and his questions about treatment of the disease. He scheduled the man for a revisit in two weeks, assuring him that he could call if any problems occurred before his appointment. He returned to his office at 10:03 to receive a phone call from a physician regarding a Bell's palsy patient. Dr. F. told the physician to send the patient in at one o'clock. He wrote his findings on the previous patient, finishing at 10:07. He then placed a call to the biostatistics department at a nearby medical school and asked for help with a problem in his research project.

At 10:10 there was a lumbar puncture scheduled for a 65-year-old man who had a history of syphilis. The man had come because of intermittent episodes of confusion and one episode of loss of memory a month ago. As he was being prepared for the lumbar puncture, the patient stated that it was a lumbar puncture that had brought him and his wife the greatest pleasure of life. The nurse and I waited anxiously for the follow-up to this surprising statement. Apparently, because his wife's sister had had a lumbar puncture with debilitating side effects, he and his wife were allowed to adopt her daughter (who is getting her Master's degree this summer). The message, as Dr. F. pointed out to me, was that the man was afraid of the lumbar puncture and didn't want the same side effects. Dr. F., assisted by a nurse, finished at 10:20 and returned to his office. He read the *New England Journal of Medicine* for a few minutes before seeing his next patient. In his free minutes between patients, while reading or filing, Dr. F. usually sings.

At 10:26 he saw a Bell's palsy patient who spoke only Spanish. Dr. F. took Hilda, a clerk who does the translating, with him to talk to the patient and found out she had pain on one side by her ear. She was using aspirin and Dr. F. and Hilda referred her to ENT. Dr. F. said Hilda was a pretty good doctor.

At 10:35 Dr. F. was reading his mail. He received a letter from Dr. H. Houston Merritt of the Neurological Institute in New York, responding to a letter from Dr. F. in which he had asked whether you should give a flu vaccination to a patient with multiple sclerosis inasmuch as the disease can be exacerbated by both the flu and the vaccination. Dr. Merritt wrote back that there was not enough evidence to evaluate the side effects of the vaccination over the risks of an infectious disease for a multiple sclerosis patient.

He also received a letter from a doctor at the medical school about a man in his 50's who had become irritable, unsociable and withdrawn. There was a question whether the man was suffering from chronic TEL (tetraethyllead) poisoning and if it was work-related.

At 10:46 Dr. F. read EEG's and at 10:55 he left by car for the county hospital with the other neurologists. In our car was a resident, a psychiatrist turned internist, who was discussing a talk he was to give on schizophrenia. (Apparently there are basic science lectures on Thursday.) During this car ride it was pointed out that the prepaid multi-specialty group practice doctors are the backbone of the voluntary attending staff at the county hospital.

From 11:15 to 12:15 we listened to a lecture on hysteria. After the lecture, we went to lunch in the hospital cafeteria.

Dr. F. saw a consult for another physician. The patient was a 40-year-old male chronic alcoholic and

Dr. F. had been asked to rule out a subdural hematoma. He had had the tests done and they were all negative. Now the man was complaining of swelling by his right ear. Dr. F. wrote this in the chart and requested an ENT man to see the patient.

At 1:10 he saw the patient he had seen yesterday on Grand Rounds, the 22-year-old woman with the diagnosis of intracranial seeding of a cervical cord glioma.

At 1:20 he was back in his office and saw the first patient after lunch, Janie, a little girl of two years and nine months who was back for a recheck for her febrile seizures. She has had no more seizures but has had fevers. Dr. F. asked that she be weighed and then waited for her in the office. He calculated the change in dosage in her medication for her new weight. The patient left and Dr. F. wrote his findings in the chart. At 1:30 he was interrupted by the receptionist, who said that the Bell's palsy patient due at one o'clock had accidentally been referred to another center but would be at this office soon. At 1:31 the receptionist interrupted again to say that the chart had also been sent to the other center but they were trying to intercept it.

At 1:33, after a phone call to another M.D., Dr. F. again began to open his mail, singing along.

At 1:35 he discussed the research projects he is doing. He has submitted the results from a questionnaire to a statistician to see if there is a statistically significant difference in perception between the sexes on the particular problem he is interested in.

At 1:55 he began examining a man referred by a G.P. The patient stated that he was not undressing because he has bronchitis and does not want to expose his chest. He stated that he has anxieties because of the difficulty he has had for the last two years with his balance. Recently he had had numbness in his left leg which has now disappeared. The question and answer period revealed only his bronchitis, no headaches, diabetes, smoking, drinking or trauma. Dr. F. asked the man to get undressed and then did a neurological examination. He left the room at 2:01, asking the patient to get dressed and come to his office. He wrote out orders for a blood test, x-rays and a nerve conduction velocities test. He gave the requisitions for the tests to the patient and scheduled him for a revisit. The diagnosis at this point is peripheral neuropathy.

At 2:04 he read charts on his desk and handled messages such as prescription refills. (At his clinic, the procedure is for the nurse to call the patient back and relay the message.) At 2:05 he received a call from another physician about a patient. He then continued with his messages. At 2:07 he got a phone call about a calculator he had purchased.

At 2:09 the nurse announced that the next patient was here. Dr. F. used the telephone to dictate his impressions on the previous patient, finishing at 2:15. At 2:15 he made a call to the bank and at 2:17 he went into the staff room to get something.

At 2:20 he went in to see an 80 year old woman, in for a recheck. The diagnosis was possible temporal arteritis. She had had two episodes which scared her in the last year and related one of these to Dr. F. The episode occurred when she was reading and got up to go to bed. She blacked out and had to sit on the floor and then lie down. A half hour later she could get up to go to bed. There was no discussion about the second episode. For the first time in the two days I was with him, Dr. F. took a patient's blood pressure and listened to her heart in addition to giving a neurological exam. He finished the exam at 2:31 and went to his office while the patient was dressing. He phoned another department to make an appointment for her to have another examination.

At 2:40 he received a phone call and discussed the transverse myelitis patient seen yesterday. He is considering writing a paper on this condition.

The patient came back into the room and sat down, saying to me that maybe the pain in her head came from lying on a hairpin. She continued chatting with me while Dr. F. was on the phone, telling me that she had had a cataract removed but that the surgery had not been very successful. Dr. F. finished making the appointment with the eye doctor and then made an appointment with the internist. He made out a requisition for a blood test and an EKG and at 2:55 the patient left. He wrote his findings in the chart on what he called the "problem oriented" form.

At 3:07 he saw his next patient, a 57-year-old woman suffering from Parkinson's disease who now walks with a four legged walking cane. He had her walk and discussed the dosage of medication she was taking. She pointed out that she falls down and has pain in her knee and hip. He finished with this patient at 3:11.

At 3:12 he saw a 44 year old man who had had a stroke and was complaining of headaches and blurred vision. After looking at him, Dr. F. suggested he see the ophthalmologist because he probably needs glasses. He wrote a prescription for phenobarbital and told the man that he still is not to drive. The patient wanted to know when he can go back to his job. (He is a bakery truck driver foreman.) Dr. F. said he could not drive until January, ten months from now.

After he left at 3:40, Dr. F. stated that the diagnosis was a questionable seizure secondary to an old cerebral hemorrhage scar.

At 3:50 Dr. F.'s last patient came in, a 20-year-old woman with a "tingling toe." She had had a positive syphilis test. He gave her a brief exam, scheduled her for a recheck in four months and finished at 3:55.

Appendix VI

Survey on Neurologic Responsibilities

One of the major charges to the Joint Commission on Neurology was the determination of the neurological manpower required for patient care in 1985. A basic element of the equation to be used in this determination is the amount of effort required of neurologists for dealing with the neurologic disease entities and symptoms to be found in the population. Such a determination involved not only an estimate of the neurological caseload but is one of the degrees to which neurologists need to be involved in the diagnosis and/or treatment of each of the disease entities and symptoms which comprise that caseload. In order to have some empirical data which could be utilized in reaching a decision on this point, it was decided to survey practicing neurologists on their judgment about the level of neurologic responsibility required.

Methodology

A list of the specific symptoms and disease entities to be evaluated in this survey was developed by a neuroepidemiologist in conjunction with experienced clinical neurologists. The goal was to select those medical problems which involve the central and peripheral nervous systems and which were assumed to have a high incidence or prevalence in the population at large and/or in clinical practice.

On the basis of this listing, two questionnaires were prepared, one dealing with symptoms, the second dealing with disease entities. The decision to have two questionnaires and thus two separate samples reflected a number of considerations. Generally, the less demanding the questionnaire the more likely is the response rate to be higher. In addition, the different formats involved for the two sets of questions might lead to some confusion among respondents. (The symptom questionnaire is given in Table 1; the disease entity questionnaire in Table 2.)

A random sample of 1,000 neurologists was drawn from the file maintained by the American Medical Association's Center for Services Research and Development. (At the time the file was provided to the Joint Commission, it listed 3,398 physicians who identified neurology as their primary specialty.)

The first 500 neurologists sampled were sent the symptom questionnaire and asked to indicate, using their clinical experience as the basis for judgement, what percentage of patients having the specified symptoms should be seen by a neurologist. The second group of 500 neurologists were sent the disease entity questionnaire and asked to classify each disease entity in terms of the percentage of patients for whom a neurologist need assume primary responsibility, assume consultative responsibility, or assume no responsibility.

At the end of five weeks, 281 of the 500 symptom questionnaires and 215 of the disease entity questionnaires had been completed and returned. At that point, follow-up letters were sent to those neurologists who had not yet responded. At the end of an additional five weeks (the cut-off point), a total of 367 usable symptom questionnaires (73 percent of those mailed), and 313 usable disease entity questionnaires (63 percent of those mailed) had been returned. (These figures do not include a total of 25 questionnaires which were returned too late to be used and 84 which could not be used—address unknown, deceased, filled out incorrectly or left blank.)

Results

Table 3 is the result of the Symptom Questionnaire. The symptoms which were most often felt to require screening by a neurologist are focal motor/sensory complaints and aphasia (78 percent of the sample deeming a neurologist necessary in all cases for both), and seizures (75 percent of the sample judging a neurologist required). Those symptoms regarded as least in need of screening by a neurologist are deafness and chronic backache, (only 6 percent and 7 percent of the sample considering a neurologist needed in all cases.)

Table 4 is the result of the Disease Questionnaire. Those disease entities judged as most often requiring the neurologist to assume primary responsibility are myasthenia gravis and Guillain-Barre Syndrome (the sample judging that 84 percent and 81 percent of all patients with these problems require a neurologist as the primary physician for the treatment of the problem.) On the other hand, patients with cerebral palsy and neurological malformations were most often seen as requiring a neurologist primarily in a consultative role.

These data were then reviewed by the Task Force on Patient Care of the Joint Commission on Neurology, serving as the starting point in the attempt to reach consensual estimates of the degree of neurologic responsibility for the various symptoms and each disease entities.

TABLE 1

Joint Commission on Neurology

Survey on Neurologic Responsibilities: A

Listed below are symptoms which may indicate Neurologic Disease. Opinions differ on the degree to which patients with such symptoms need to be seen by a Neurologist. On the basis of your experience, what would you say was the approximate percentage of patients with each of the symptoms listed below who should be seen by a Neurologist? Please circle the category which in your judgment comes *closest* to best clinical practice.

	None or Very Few	About 25% of All Patients	About 50%	About 75%	Almost 100%
Syncope	None/Few	25%	50%	75%	100%
Dementia	None/Few	25%	50%	75%	100%
Mental Retardation	None/Few	25%	50%	75%	100%
Acute Headache	None/Few	25%	50%	75%	100%
Chronic Headache	None/Few	25%	50%	75%	100%
Chronic Backache	None/Few	25%	50%	75%	100%
Other Pain Problem	None/Few	25%	50%	75%	100%
Focal Motor/Sensory Complaints	None/Few	25%	50%	75%	100%
Incoordination	None/Few	25%	50%	75%	100%
Seizures	None/Few	25%	50%	75%	100%
Incontinence	None/Few	25%	50%	75%	100%
Diplopia	None/Few	25%	50%	75%	100%
Vertigo	None/Few	25%	50%	75%	100%
Deafness	None/Few	25%	50%	75%	100%
Dysphagia	None/Few	25%	50%	75%	100%
Aphasia	None/Few	25%	50%	75%	100%
Noncorrectible Visual Loss	None/Few	25%	50%	75%	100%

COMMENTS

TABLE 2

Joint Commission on Neurology

Survey of Neurologic Responsibilities: B

Below is a list of some problems which may require Neurological care. Opinions differ on the degree to which patients with such problems require medical treatment by a Neurologist. Please insert the percentage of patients with such conditions that you consider it necessary for a neurologist to assume primary responsibility, to assume consultative responsibility, or to assume no responsibility. For example, you might consider it necessary for a neurologist to assume primary responsibility in 20% of all chronic stroke cases, consultative responsibility in 50% of such cases, and to assume no responsibility in 30% of chronic stroke cases.

	Primary Responsibility	Consultative Responsibility	No Responsibility
Acute Stroke			
Chronic Stroke			
TIA			
Muscular Dystrophies			
Polymyositis			
Myasthenia Gravis			
Guillain-Barre			
MS & other demyelinating diseases			
ALS (MND)			
Meningitis			
Encephalitis			
Brain Tumor			
Brain Tumor Suspect			
Seizures			
Dementia			
Mental Retardation			
Cerebral Palsy			
Neurologic Malformations			
Acute Head Trauma			
Acute Spine Trauma			
Residua of Head Injury			
Residua of Spine Injury			
Parkinsonism			
Other Basal Ganglia Diseases			

9/72

TABLE 3

Responses by 367 Neurologists as to Degree of Responsibility of Neurologists for Selected Symptoms

	None or Very Few	About 25% of All Patients	About 50%	About 75%	Almost 100%	N
	%	%	%	%	%	
Syncope	9	35	26	17	13	367
Dementia	5	44	10	16	65	367
Mental Retardation	10	19	23	14	33	367
Acute Headache	10	26	18	19	27	367
Chronic Headache	5	26	33	18	19	367
Chronic Backache	24	37	24	7	7	367
Other Pain Problem	11	43	31	11	5	367
Focal Motor/Sensory Complaints	27	2	4	14	78	367
Incoordination	3	3	7	20	67	365
Seizures	1	4	9	11	75	367
Incontinence	12	30	28	14	16	367
Diplopia	5	35	13	26	53	367
Vertigo	1	21	34	25	19	360
Deafness	20	43	25	7	6	367
Dysphagia	11	25	31	16	17	367
Aphasia	3	2	4	14	78	367
Non Correctible Visual Loss	8	17	24	17	34	367

TABLE 4

Responses by 313 Neurologists as to Degree of Neurologic Responsibility for Specified Disease Entities

ACUTE STROKE

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
	%	%	%	%	%	
Primary Responsibility	6.7	16.6	31.3	11.5	33.9	55.3
Consultative Responsibilitiy	17.3	25.0	32.1	11.9	13.8	39.8
No Responsibility	79.9	14.4	4.2	1.3	0.3	4.9

CHRONIC STROKE

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	27.5	50.8	18.2	1.3	2.2	17.7
Consultative Responsibility	4.2	8.6	39.0	15.3	32.9	58.7
No Responsibility	44.4	18.8	25.9	6.7	4.2	22.6

TRANSIENT ISCHEMATIC ATTACK

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	7.3	8.6	23.0	9.6	51.4	67.3
Consultative Responsibility	35.8	21.7	25.9	4.8	11.8	29.1
No Responsibility	89.1	7.3	3.2	0	.32	2.5

MUSCULAR DYSTROPHIES

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	14.4	16.9	24.0	8.6	36.1	53.8
Consultative Responsibility	24.6	18.2	25.9	9.9	21.4	42.0
No Responsibility	87.9	6.7	3.8	1.0	.6	3.8

TABLE 4

Responses by 313 Neurologists as to Degree of Neurologic Responsibility for Specified Disease Entities—Continued

BRAIN TUMOR SUSPECT

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	5.1	6.1	16.6	11.2	61.0	75.2
Consultative Responsibility	47.9	19.8	20.4	3.2	8.6	22.6
No Responsibility	91.4	6.4	2.2	0.0	0.0	1.8

SEIZURES

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	2.6	11.2	18.9	15.7	51.6	70.6
Consultative Responsibility	36.2	26.6	22.8	6.4	8.0	26.3
No Responsibility	86.6	8.9	3.8	0.3	0.3	3.1

DEMENTIA

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	15.0	27.8	26.8	8.3	22.0	43.0
Consultative Responsibility	17.6	13.7	30.4	15.7	22.7	47.9
No Responsibility	70.6	16.6	9.9	1.0	1.9	8.9

MENTAL RETARDATION

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	31.0	38.7	21.1	2.9	6.4	23.7
Consultative Responsibility	7.3	10.9	35.1	16.3	30.4	57.5
No Responsibility	56.2	13.7	19.5	5.4	5.1	18.4

ALS (MND)

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	7.7	12.1	18.2	8.6	53.4	66.7
Consultative Responsibility	63.8	19.9	17.9	7.4	16.7	31.7
No Responsibility	92.3	6.1	1.3	0.3	0.0	1.5

MENINGITIS

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	14.4	23.3	36.4	7.0	18.8	43.0
Consultative Responsibility	11.2	16.6	42.2	11.5	18.5	47.7
No Responsibility	76.4	10.9	8.0	3.8	9.6	8.5

ENCEPHALITIS

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	6.4	10.9	23.3	13.1	46.3	65.5
Consultative Responsibility	30.4	23.6	27.8	6.1	12.1	32.2
No Responsibility	89.8	8.6	0.96	0.6	0.0	2.3

BRAIN TUMOR

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	14.4	18.2	29.1	8.3	30.0	50.8
Consultative Responsibility	—	—	—	—	—	—
No Responsibility	80.5	9.3	4.8	3.2	2.2	7.7

TABLE 4

Responses by 313 Neurologists as to Degree of Neurologic Responsibility for Specified Disease Entities—Continued

POLYMYOSITIS

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	11.5	14.7	32.6	10.5	30.7	54.0
Consultative Responsibility	21.7	15.3	39.6	9.6	13.7	40.3
No Responsibility	81.8	10.9	5.7	1.0	0.6	5.3

MYASTHENIA GRAVIS

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	1.5	2.9	11.9	8.7	74.9	84.3
Consultative Responsibility	56.7	25.0	12.8	2.2	3.2	14.6
No Responsibility	93.9	4.8	1.0	0.0	0.3	1.3

GUILLAIN-BARRE

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	3.5	3.5	13.5	11.9	67.6	81.0
Consultative Responsibility	47.3	27.8	18.8	2.9	3.2	18.1
No Responsibility	96.7	3.0	0.3	0.0	0.0	.8

MS & OTHER DEMYELINATING DISEASES

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	4.5	5.4	19.5	12.1	58.5	74.3
Consultative Responsibility	40.4	24.4	23.7	4.5	7.1	24.5
No Responsibility	93.9	5.4	0.6	0.0	0.0	1.0

CEREBRAL PALSY

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	29.7	40.9	20.4	3.2	5.8	22.9
Consultative Responsibility	5.8	9.3	32.9	15.0	37.1	60.6
No Responsibility	60.3	13.2	17.0	5.4	4.1	15.4

NEUROLOGIC MALFORMATIONS

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	25.6	33.2	29.4	3.8	8.0	28.1
Consultative Responsibility	8.0	8.0	32.3	16.6	35.1	59.4
No Responsibility	70.3	10.2	14.7	3.2	1.6	11.4

ACUTE HEAD TRAUMA

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	30.7	30.0	22.4	3.2	13.7	30.2
Consultative Responsibility	13.4	20.4	32.6	9.3	24.3	46.8
No Responsibility	58.8	8.3	15.3	5.8	11.8	22.7

ACUTE SPINE TRAUMA

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	32.9	29.1	19.8	2.9	15.3	29.3
Consultative Responsibility	18.2	17.3	29.1	11.5	24.0	45.5
No Responsibility	58.1	7.7	14.4	6.7	13.1	24.0

TABLE 4

Responses by 313 Neurologists as to Degree of Neurologic Responsibility for Specified Disease Entities—Continued

RESIDUA OF HEAD INJURY

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	20.1	32.9	31.0	5.8	10.2	32.3
Consultative Responsibility	9.3	15.0	39.3	14.1	22.4	50.8
No Responsibility	59.1	16.9	14.7	4.5	4.8	16.6

RESIDUA OF SPINE INJURY

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	24.6	35.8	26.5	7.0	6.1	27.3
Consultative Responsibility	7.3	15.0	37.4	14.8	25.9	53.3
No Responsibility	58.1	13.4	16.6	5.1	6.7	18.3

PARKINSONISM

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	3.2	7.0	19.5	15.3	54.0	71.8
Consultative Responsibility	33.9	29.4	25.6	6.7	4.5	25.2
No Responsibility	85.6	10.2	3.8	0.0	0.3	2.9

OTHER BASAL GANGLIA DISEASES

Percentage:	0	1–25	26–50	51–75	76–100	Mean Score in Percent
Primary Responsibility	2.9	6.1	19.6	14.1	57.4	74.8
Consultative Responsibility	38.1	27.9	24.4	5.4	4.2	22.9
No Responsibility	89.4	8.4	1.8	0.0	0.4	1.9

Appendix VII

Task Force Definitions of Neurologic Responsibilities

In order to develop an estimate of the degree to which neurologists need to be involved in the diagnoses and/or treatment of each of the major neurological symptoms and disease entities, the members of the Task Force on Neurological Services:

1. Reviewed the results of the Survey on Neurologic Responsibilities.
2. Developed, on the basis of these results and of their own clinical experiences, a consensual estimate of the need for involvement by neurologists in the diagnoses and treatment of the various symptoms and disease entities.
3. Prepared statements on the various symptoms and entities, the purpose of which is to explicate the rationale underlying the consensual estimates.

In general, the Task Force members recommended a greater degree of involvement by neurologists in diagnosis and treatment than did the respondents in the Survey on Neurologic Responsibilities. A multiplicity of reasons was undoubtedly involved, some of which can be identified. The Task Force members explicitly focused upon optimal or ideal care while the respondents in the survey were not given this charge. Indeed, they were asked to judge on the basis of their clinical experience (necessarily derived from practice in a less than perfect world). In addition, respondents to the disease entity questionnaire were constrained by the format to allocate levels of neurolgocial responsibility on a mutually exclusive basis. Thus, it was not possible to respond that 80 percent of patients with convulsive disorders need consultation by a neurologist while 50 percent of them require continuing care by neurologists; the total percentage always had to equal 100 percent. The Task Force, however, did not limit itself in this manner. Hence, the two sets of judgments on disease entities are roughly rather than strictly comparable. (Responses to the symptom questionnaire which were in terms of the percentage "who should be seen by a neurologist" may, however, be regarded as equivalent to the Task Force conclusions as to percent to be seen in consultation.)

The rationales developed by the Task Force, including a summary of the two sets of judgments on responsibility for symptoms and disease entities, follow.

ACUTE HEADACHE

Sample of Neurologists:	Task Force conclusions:
57% should be seen	100% consultation
	50% continuing care

Acute headache is a term applied to severe, unrelieved head pain experienced for the first time. As it usually occurs, the headache is associated with more general symptoms, such as weakness, and efforts at its relief fail.

The reasons for referral are either the fever experienced by the patient (which in association with the headache may indicate an illness such as meningitis) or the rupture of an abnormal blood vessel (aneurysm or arteriovenous malformation). When migraine is diagnosed, the neurologist both establishes the diagnosis and outlines a plan of treatment. Cluster headaches resemble migraine in severity but the headaches tend to occur in groups, often disturbing or disabling patients for several days. Treatment is often difficult and frequently requires intensive observations and repeated efforts at relief. Headache associated with cranial or giant cell arteritis is part of an acute inflammatory disease of the arteries occurring in the elderly which may result in blindness. Prompt, appropriate treatment may prevent a limited visual loss and relieve the headache.

Acute headache may be associated with meningitis and brain tumors and in those cases early recognition is essential for successful treatment.

ACUTE HEAD TRAUMA

Sample of Neurologists:	Task Force conclusions:
47% consultative responsibility	100% consultation
30% primary responsibility	100% continuing care

About 400,000 new cases of acute head injury occur annually in the United States. Acute injuries to the head may result in injury to the brain. The effects can include disordered body chemistry, headache, deep coma, a progressive drowsiness or paralysis, brain swelling and alteration of breathing. Only by careful examination can one determine the true extent of the consequences of brain damage and institute appropriate life saving procedures. In addition, the late consequences of head injury may include dementia resulting from lack of oxygen during the acute phase.

The neurologist decides upon the proper diagnostic studies and their timing and significance in the total care of the patient. Most cases of acute head injury will suffer from bruising or tearing of brain tissue and the resulting symptoms will be determined by the severity of the injury and its location. During the acute phase, the patient's condition is constantly changing and only by repeated examinations can one follow the course of the illness and thus institute procedures to favorably influence the outcome.

ACUTE SPINAL CORD INJURY

Sample of Neurologists:	Task Force conclusions:
45% consultative responsibility	100% consultation
29% primary responsibility	67% continuing care

Spinal cord injury occurs about 4,000 times a year in the United States and results in loss of feeling sensations and of bowel, bladder and sexual function. Most patients survive for many years. Presently there are about 100,000 survivors of spinal cord injury who require continuing care. Of these about 10,000 are veterans. Regretably, in nearly every instance the spinal cord has been irreversibly damaged by the time aid reaches the patient. The initial care frequently demands the cooperation of several medical specialists because of multiple injuries, shock and severe disorder of body chemistry.

Whether or not the injury is of the nervous system alone, the neurologist plays an important role in diagnosis, treatment and organizing and directing a care program. The long-term aim of this program is to provide comprehensive care to the patient with particular attention to food and fluid, skin, limbs, joints and care for the paralyzed bladder and bowel. Modern management of spinal cord injury involves the use of special beds and other devices which are designed to equalize the distribution of pressure on the skin surface.

An important task for the neurologist is the instruction and supervision of nursing and other personnel in preventing, recognizing and coping with complications such as abnormally low blood pressure or crises of blood pressure elevation. During the entire initial phase of injury, constant attention to and interpretation of the changing neurological signs require a trained observer so that the patient's care may be appropriate.

ACUTE STROKE

Sample of Neurologists:	Task Force conclusions:
40% consultative responsibility	100% consultation
55% primary responsibility	67% continuing care

Annually, there are about 400,000 new cases of stroke in the United States. In acute stroke a portion of the brain dies as the result of disordered blood supply. The patient becomes speechless or paralyzed or loses a portion of his vision or sensation, depending on the area of brain affected. These events may occur suddenly or stepwise. One goal of treatment is to limit the extent of the stroke and hence the residual disability. The neurologist's task is to establish the proper diagnosis, differentiate other conditions, evaluate the cause and extent of the stroke and institute treatment. His assessment leads to the performance of only those diagnostic procedures which are necessary.

Understanding the natural history of stroke, a neurologist is able to outline a program of initial medical and psychological management for the patient and progression into the rehabilitative procedures. His support of the family will often assist them in coping with the catastrophe and enable them to help the individual to make the maximal functional recovery. A less than optimal program or delay in initiating an appropriate program decreases the level of eventual function.

About one-third of all strokes will be relatively mild and the clinical picture fairly clearcut. These cases should be the primary responsibility of the family physician, requiring only an initial neurological consultation. However, in about two-thirds of cases the neurologist should ideally have a primary or continuing responsibility for the patient's care.

AMYOTROPHIC LATERAL SCLEROSIS

Sample of Neurologists:	Task Force conclusions:
32% consultative responsibility	100% consultation
67% primary responsibility	100% continuing care

Amyotrophic lateral sclerosis strikes about 2,000 people each year in the United States and at any one time there are about 10,000 victims of the disease. It is a progressive neuromuscular disorder of adult life for which there is as yet no cure. As the disease progresses the patient becomes bedfast and unable to move his limbs while remaining conscious and aware of his plight. Because the disease leads inevitably to death in an average of three years, the diagnosis must be made with utmost certainty and the possibility of a less life-threatening or even curable disorder must not be over-looked.

Diagnosis, which is dependent upon an awareness of those disorders causing paralysis and is thus within the area of special competence of the neurologist, is established by a neurologic examination and history and by the use of neurologic tests such as the electromyogram.

With his knowledge of the disease and of patients' and their families' responses to it, the neurologist can help the family and patient to live with this fatal disorder.

APHASIA

Sample of Neurologists:	Task Force conclusions:
91% should be seen	100% consultation
	100% continuing care

Aphasia is an acquired disorder of the use of language which always results from some organic or structural disease of the brain. It is often associated with disorder of the conceptualization of movement (apraxia) or of recognition of the nature of objects or stimuli (agnosia). When aphasia is linked to paralysis of the face and arm and the patient has great difficulty speaking, its nature is obvious but in many instances where the patient speaks fluently, the language disorder is subtle. The ultimate identification of the aphasia and diagnostic evaluation, searching for its causes by the application of highly complex diagnostic methods, is usually performed by a neurologist. The design, evaluation and supervision of treatment (though not necessarily the actual treatment), and interpretation and counselling of the patient and his family are prime responsibilities of the neurologist. When possible this is done in association with a speech pathologist.

The most important function to be performed in each case is to define the cause of aphasia, apraxia or agnosia in structural terms and to design strategies for amelioration. In the case of the juvenile language disorders, especially those involving the pre-school child, the pediatric neurologist performs all the functions of the adult neurologist and in addition bears the important responsibility of collaborating with the parents, the school and community agencies in planning and supervising appropriately designed educational programs for the child.

BACTERIAL MENINGITIS

Sample of Neurologists:	Task Force conclusions:
48% consultative responsibility	100% consultation
43% primary responsibility	

Bacterial meningitis is an infection of the tissues covering the brain. This space, which is filled with spinal fluid, is particularly vulnerable because it lacks the natural defense mechanisms necessary to wall off and arrest infection.

Meningitis, uniformly fatal if untreated, is often entirely curable if properly and promptly treated. The disease strikes quickly and progresses rapidly. The course of untreated meningitis from onset to death may span less than 24 hours. The most disastrous errors in this dramatic illness are made by delay in initial diagnosis. By virtue of training and experience, the neurologist brings to possible meningitis patients a high index of suspicion, as well as skill in performing and directing the initial spinal fluid examination and instituting treatment. Furthermore, he is trained to anticipate complications such as seizures, subdural effusions and postmeningitic hydrocephalus.

BASAL GANGLIA DISEASES (EXCLUDING PARKINSONISM)

Sample of Neurologists:	Task Force conclusions:
23% consultative responsibility	100% consultation
75% primary responsibility	75% continuing care

The term "other basal ganglia diseases" refers to such diverse problems as hepatolenticular degeneration, kernicterus, Huntington's chorea, carbon monoxide poisoning and a variety of other obscure illnesses, many of which are difficult diagnostic problems. Patients with basal ganglia disease have incoordinated involuntary movements, often sudden, often bizarre, always distressing and causing varying degrees of disability. For this reason we feel that every patient with basal ganglia disease should be seen by a neurologist and about three-quarters of such patients should continue under the care of a neurologist.

The correct initial diagnosis is of utmost importance because some movement disorders are benign, some are amenable to treatment and some are marked by relentless progression, disability and death. Recent advances in knowledge have provided treatment for conditions such as Wilson's disease, formerly regarded as an untreatable degeneration.

BRAIN TUMORS

Sample of Neurologists:	Task Force conclusions:
42% consultative responsibility	100% consultation
51% primary responsibility	100% continuing care

About 20,000 people develop primary brain tumors annually in the United States and at any one time there are about 80,000 people suffering from the condition. Brain tumors present a complex set of problems because they are heterogeneous rather than uniform and because of the unique anatomy of the brain and skull. First, after early childhood the brain is enclosed in a rigid unyielding box, the skull. Any growth within the skull may compress adjacent soft structures for a while but eventually all spare room is consumed and the growth places the brain and brain stem under pressure. This will result in headaches, impaired consciousness and eventual death. Second, brain tumors may arise from the coverings of the brain or the nerves outside the brain, doing their mischief by pressing on the brain and other structures within the skull. Still other tumors arise within the brain substance, damaging it directly. Third, the tumor may arise in a variety of locations within the head, producing different effects and deficits depending upon the structures damaged. Finally, brain tumors are of varying degrees of malignancy; some are benign, some arise primarily within the head and still others are metastatic from other organs. Proper management must consider all of these factors.

Because of these complexities, optimal care of patients with brain tumors requires active participation by the neurologist. At certain phases of management, the special talents of a neurosurgeon are required and the care of the patient with brain tumor becomes a cooperative team project.

BRAIN TUMOR SUSPECT

Sample of Neurologists:	Task Force conclusions:
23% consultative responsibility	100% consultation
75% primary responsibility	100% continuing care

Progressive neurological symptoms raise the suspicion of brain tumor. The special role of the neurologist consists of evaluating the clinical state of the patient, deciding which diagnostic procedures are required and when, continuing to observe the patient and providing necessary reassurance and guidance.

CEREBRAL PALSY

Sample of Neurologists:	Task Force conclusions:
61% consultative responsibility	75% consultation
23% primary responsibility	25% continuing care

Annually, about 6,000 children develop cerebral palsy. At any given time about 120,000 people in the United States suffer from this condition. Cerebral palsy is a general term used to describe the clinical manifestations resulting from a disease or injury to the brain caused before or during birth. The common features include abnormalities of movement and posture, seizures, speech difficulties, impaired intellectual development and distortion of physical growth.

The primary responsibility of the neurologist is assessment of the neurological deficit, identification of remediable conditions and appropriate treatment, especially of movement disorders and seizures. This latter group will require continued care. In addition, the neurologist collaborates with other physicians and often with school districts regarding programs for groups of such children. One of the most important services rendered the patient is that of counselling and advising his parents concerning the positive traits of the child and the ways in which he can be included within the family structure.

CHRONIC BACKACHE

Sample of Neurologists:	Task Force conclusions:
27% should be seen	17% consultation
	17% continuing care

About one-sixth of patients with the primary complaint of low back pain should be under the care of a neurologist, an additional one-sixth should be seen in neurologic consultation and two-thirds do not require neurologic attention.

Low back pain is one of the most common complaints presented to physicians and it is obviously impractical for all such patients to be seen by a neurologist. However, it is of great importance to arrive at a precise diagnosis as quickly as possible in order that the patient can be spared suffering and disability. Neurologic history and examination alone will very often separate those patients with disc protrusion and radicular pain from those with such conditions as diabetic femoral plexopathy. Symptoms of spinal cord compression must be recognized early in order to avoid permanent handicap. The experience of the neurologist may enable him to establish a diagnosis with a minimum of expensive and complicated testing and to initiate treatment with the least delay.

CHRONIC BRAIN INJURY (RESIDUA OF HEAD INJURY)

Sample of Neurologists:	Task Force conclusions:
51% consultative responsibility	25% consultation
32% primary responsibility	25% continuing care

Following convalescence from acute head injury, many patients continue to have disabling symptoms. Impairment of motor and sensory function may occur as a result of brain damage. Frequently the patient has impairment of his intellectual capacity, dementia and post-traumatic seizures as a consequence of his brain injury. The recognition of these symptoms and their differentiation from frequently associated psychiatric symptoms require complete neurologic evaluation. The neurologist is qualified to advise the patient with chronic brain injury and supervise his rehabilitative program.

CHRONIC HEADACHE

Sample of Neurologists:	Task Force conclusions:
56% should be seen	67% consultation
	33% continuing care

Headache results from innumerable causes. The most common headache is thought to result from sustained tension of the neck and scalp muscles. The second most common headache is migraine or vascular which is thought to result from dilatation of the blood vessels of the head. (Migraine severe enough to require medical attention afflicts about 1 million people in the United States at any given time and about 200,000 new cases develop annually.) Many people suffer severe recurrent or persistent headaches that significantly interfere with a productive and enjoyable life. Despite available effective treatment programs for common headaches syndromes, huge quantities of medication which are ineffective, habituating and potentially harmful are being used because of improper diagnosis and treatment. Neurological evaluation is needed to classify the headache, rule out structural causes or growths and select the most appropriate treatment. The neurologist's familiarity with these conditions and the disorders which mimic them, with the techniques of neurological examination and with the methods of treatment enable him to treat these patients effectively.

CHRONIC STROKE

Sample of Neurologists:	Task Force conclusions:
59% consultative responsibility	75% consultation
18% primary responsibility	25% continuing care

At any one time there are about 1 million people in the United States suffering from cerebrovascular disease or stroke. Patients with chronic stroke may have disabling symptoms such as paralysis, speech disorder, urinary incontinence, incoordination of disorders of perception. A team approach that may involve workers in physical medicine, speech pathology, social service and occupational therapy is frequently needed. The neurologist is often in the best position to quarterback such a team. His knowledge of the character of brain lesions makes him best suited to help solve problems of the brain injured and to empathize with the family.

Treatment may include measures to prevent further strokes with treatment of the underlying vascular disease, blood disease or metabolic disorder and may involve several different kinds of specialists. A majority of patients require consultative guidance from a neurologist. A minority of patients have problems of sufficient complexity to require continued long-term management primarily by a neurologist.

DEAFNESS

Sample of Neurologists:	Task Force conclusions:
35% should be seen	15% consultation
	5% continuing care

About 200,000 people annually in the United States develop noticeable deafness (a hearing loss greater than 35 decibels) and at any one time, it is estimated, there are four million noticeably deaf Americans. The neurologist is consulted in cases of deafness when hearing loss is associated with double vision, facial numbness, lack of muscular coordination, impaired facial movement or altered language function because this association often indicates that disease of the nervous system is responsible for both sets of symptoms. His skills are required in analysis of the history and determination of the full extent and nature of the neurological deficits, to decide whether there is a linkage between the deafness and the disorder of nervous system function. His conclusions often depend on his requesting, performing or interpreting special diagnostic tests.

When the diagnosis has been established, the neurologist decides on treatment. Because in many cases the decision is reached only after a prolonged interval, the neurologist may also provide the patient symptomatic relief while continuing to evaluate him.

DEMENTIA

Sample of Neurologists:	Task Force conclusions:
Questionnaire A:	100% consultation
83% should be seen	25% primary care
Questionnaire B:	
48% consultative responsibility	
43% primary responsibility	

Dementia is estimated to strike 80,000 people each year in the United States. Defined as the sustained decline of intellectual power from a previously attained level, it is the result of brain disease of biochemical or structural causes including injury, multiple strokes, degenerative disease, infection and tumor. It may affect young as well as older people. Some cases are potentially correctable. Demented patients currently occupy nearly one-fourth of all hospital beds in the United States. Many are housed in state and veterans' psychiatric facilities.

One of the brightest chapters in modern neurology is its role of leadership in the problem of dementia, both in research and in clinical practice. A leading example is the eradication of neurosyphilis by energetic case finding and treatment. Research interest in dementing disorders is and has been almost exclusively expressed by neurologists. The diagnostic evaluation of these patients is provided in neurological clinics or by practicing neurologists. The recognition of the nature of the illness, study of its characteristics, quantification of the deficit, identification of its mechanism and early institution of treatment are all largely the responsibility of neurologists and, based on current practice patterns, will remain so in the future. Neurologists serve on the professional boards of socieites such as the Committee to Combat Huntington's Disease and other health education groups, or assist in the organization of appropriate community care and health facilities.

DIPLOPIA

Sample of Neurologists:	Task Force conclusions:
46% should be seen	100% consultation
	100% continuing care

It is the opinion of this group that the symptom of diplopia should be seen and managed by a neurologist in every case. Double vision is virtually always a symptom of neurologic disease and the neurologist is best suited to separate those with intracranial tumors and aneurysms from those with myasthenia gravis and demyelinating disease. The correct diagnosis can often be made on the basis of initial history and neurologic examination and the patient may thus be spared expensive, uncomfortable and sometimes dangerous diagnostic studies. Once the diagnosis is established, a few patients will require referral to other specialists for treatment.

DYSPHAGIA

Sample of Neurologists:	Task Force conclusions:
51% should be seen	66% consultation

Dysphagia, difficulty in swallowing, is a most distressing symptom for the patient. It may lead to impairment of his airway and thus to pneumonia or even death. If the symptom is persistent, it leads to weight loss and starvation and finally to death.

Dysphagia does not normally interfere directly with a patient's ability to work in a productive fashion; however, the seconday symptoms of impaired respiratory function and/or weakness because of weight loss will eventually interfere with a patient's ability to be economically useful in our culture.

In approximately two-thirds of patients in whom the etiology is not readily apparent on examination of the throat and upper esophagus, dysphagia usually is due to impaired neuromuscular function. Many of the causes of such impaired neuromuscular function are treatable. They include such disorders as myasthenia gravis, polymyositis and the bulbar palsies.

A correct diagnosis is dependent upon knowledge of the neurologic syndromes which occasion such disorders and is made on the basis of neurologic examinations and histories. The diagnosis usually is established by the use of specialized techniques such as the tensilon tests and electromyographic examinations.

The treatment is often highly specialized and, particularly in such disorders as myasthenia gravis, may require continued care by physicians trained in neurology.

ENCEPHALITIS

Sample of Neurologists:	Task Force conclusions:
32% consultative responsibility	not given
65% primary responsibility	

Each year about 4,000 people in the United States develop encephalitis, the term generally taken to mean infection of the brain and nervous system. Diagnosis and treatment of this disease fall to neurologists both by interest and by default, since it is often a discouraging problem for which treatment is long and arduous.

Patients with encephalitis may present with fever, headache, delirium, convulsions or coma The course of the disease may be brief and self-limited or prolonged. Encephalitis carries a significant mortality and many patients who survive are left with grave handicaps from paralysis to imbecility.

Precise diagnosis is of critical importance. Encephalitis is caused by a variety of agents such as virus, parasites or toxic chemicals and treatment varies accordingly. Knowledge about encephalitis has increased appreciably in the last ten years, resulting in new approaches to treatment. Some diseases formerly regarded as degenerative diseases are now known to result from slowly progressive virus infections. The changes induced by slowly acting virus have important implications for the future treatment of encephalitis and for some tumors.

Once the diagnosis is established, encephalitis patients require prolonged care as well as great understanding. The mental and psychological effects of encephalitis are unfamiliar to most physicians and are a particularly difficult problem for families.

FOCAL SYMPTOMS AND SIGNS

Sample of Neurologists:	Task Force conclusions:
91% should be seen	100% consultation
	100% continuing care

The appearance of local weakness or loss of sensation always indicates involvement of the nervous system. The significance of such complaints for the health of the individual can usually be determined by examination of the nervous system and interpretation of associated symptoms and signs, supplemented by selected laboratory findings. Since the appearance of such focal motor or sensory findings suggests the presence of neurological disease, it is imperative that all such cases have the benefit of neurological consultation. The associated diagnostic findings, often mild or minimal early in the illness, may be completely overlooked unless exposed to neurological survey. Moreover, judgment as to the properly needed laboratory procedures should have the benefit of a specialist in neurological diseases. With such medical care, many neurological problems may be detected early and treated before irreversible damage to the nervous system, with its associated disabilities or permanent crippling, has resulted.

GUILLAIN-BARRÉ

Sample of Neurologists:	Task Force conclusions:
18% consultative responsibility	100% consultation
81% primary responsibility	100% continuing care

Annually in the United States about 2,000 people develop Guillain-Barré disease. This disease affects nerves and nerve roots in people of all age groups and may present with complete paralysis of all limbs and failure of breathing or with mild discomfort in the limbs. It may remain stationary or progress rapidly, resulting in death from involvement of the breathing mechanisms. It is a reversible disease which will clear up if the patient can be properly diagnosed, adequately protected and thus kept alive. Because of the marked variability in its manifestations, it is often a very difficult disease to diagnose early and can be, and often is, mistaken for other neurological illnesses. Because its course is often misjudged, a number of Guillain-Barré patients die before protective methods are instituted.

Since the care of these patients is dependent upon the diagnosis and interpretation of hour by hour neurological monitoring, these patients should remain under neurological care. If properly treated, most patients should recover completely, regardless of the severity of the illness or the length of its duration.

INCONTINENCE

Sample of Neurologists:	Task Force conclusions:
48% should be seen	30% consultation
	15% continuing care

Incontinence of urine or feces is not a primary disease entity but often results from disease of nerve roots, spinal cord or brain. It may, in the case of the former two conditions, be the first symptom. Such cases may occur in children and adolescents and require differentiation from psychological disorders. Nearly all incontinent adults who are without structural abnormality of the gastro-intestinal or genito-urinary systems suffer some neurological disorder. The neurological role in the care of these patients may be extensive beyond diagnosis. Neurologists take responsibility for designing and introducing such special rehabilitative techniques as bladder retraining through intermittent catheterization, establishing bowel and extended bladder care programs, the training of nurses and other health personnel to maintain and teach care programs to patients and families and the prescribing of drugs or other treatments needed to keep the urinary system and bowel in the healthiest possible state. Though any physician should be able to carry out this function, the widespread unfamiliarity with diagnostic methods and treatment techniques and the common linkage of these conditions to neurological illness combine to give the neurologist a large role in the care of incontinence.

INCOORDINATION

Sample of Neurologists:	Task Force conclusions:
86% should be seen	100% consultation
	100% continuing care

Incoordination is a symptom rather than a disease entity. The word implies impairment of accurate coordinated movements and movement patterns. Most commonly it is applied to the use of the extremities for skilled voluntary acts but it may indicate impairment of coordinate gait or speech. Other words used for incoordination include cerebellar disorder, ataxia, clumsiness, staggering, imbalance or drunkenness.

In occasional instances the cause of incoordination may be obvious. Such instances include untoward reaction to prescribed drugs, excessive use of alcohol or excessive drug use. In these circumstances the incoordination is usually transient.

With the exception of such obvious circumstances, essentially all cases of incoordination should be examined by a neurologist. Incoordination may result from impairment of sensory pathways; damage to the cerebellum, its input or output; lesions of certain portions of the cerebrum. Loss of balance may also result from failure of the labyrinths of the inner ear. A wide variety of disease processes may be responsible for impairment of the structures cited. These processes include tumors, vascular disease, multiple sclerosis, toxic processes, degenerative disorders, infections and inflammations, among others. Proper management, dependent upon accurate determination of the site and cause of the lesion producing ataxia, requires the skills of a person fully trained in neurologic techniques.

MENTAL RETARDATION

Sample of Neurologists:	Task Force conclusions:
Questionnaire A	67% consultation
60% should be seen	15% continuing care
Questionnaire B	
57% consultative responsibility	
24% primary responsibility	

Mental retardation is estimated to affect about two million people in the United States at any one time. Severe mental retardation occurs annually in about 14,000 people and at any given time about 200,000 suffer from the condition. The term is applied to a group of illnesses which have in common impaired intellectual and mental development. The neurologist undertakes those procedures needed to establish a diagnosis because retardation can result from several disease states which affect the brain, some of which are curable or reversible. Not all patients persumed to be so are in fact retarded; language and motor disorders, as well as some cases of epilepsy, are sometimes confused with mental retardation. The special training and skills of the neurologist equip him to differentiate among these patients.

With other professionals, the neurologist plans treatment and educational programs based on his assessment of the neurological deficit. The neurologist also deals with the broader problems of the family, both in caring for the child and in helping the family to compensate for the disruption caused by the retardation.

MULTIPLE SCLEROSIS

Sample of Neurologists:	Task Force conclusions:
24% consultative responsibility	100% consultation
74% primary responsibility	100% continuing care

Multiple sclerosis strikes about 4,000 people annually in the United States. At any given time, it is estimated, there are about 100,000 cases of the disease, an intermittent progressive disease of the central nervous system which may cause paralysis, blindness, incoordination and other grave losses of function in young adults. Its cause is not known and no specific treatment is available. The character of the initial symptoms may vary from patient to patient. The progression of the illness may be interrupted by long periods of stability or improvement. The degree of involvement may vary from minimal to helplessness.

Because of the complexity of the illness, the neurologist has a primary role in identifying its nature and separating it from other potentially treatable conditions. This done, he helps to maintain the patient's physical well-being by prescribing appropriate physical and drug treatment to help the patient compensate for specific features of the disease. He also reinforces the patient's social and psychological defenses.

MUSCULAR DYSTROPHY

Sample of Neurologists:	Task Force conclusions:
42% consultative responsibility	100% consultation
54% primary responsibility	100% continuing care

At any given time, about 12,000 people in the United States suffer from muscular dystrophy and about 1,000 new cases appear annually. Neurologists have assumed the responsibility for the diagnosis and management of patients with muscle disease and the establishment of special clinics for this purpose. Nearly all of the research in this area has been carried out in neurology laboratories. The necessary diagnostic skills, including special electrical studies, and the interpretation of muscle biopsies have been carried out primarily, although not exclusively by neurologists.

Muscular dystrophy per se is a reasonably well-defined group of diseases but the diagnosis of "muscular dystrophy" is frequently attached to a variety of other disturbances involving muscle. The first concern of the neurologist, therefore, is to establish the correct diagnosis, in particular since a number of conditions which closely resemble muscular dystrophy are amenable to treatment if properly recognized. Once the diagnosis is established by the neurologist, the continued management and treatment should be completely within the hands of the neurologist. Counseling, employment, rehabilitation and re-education are complex and require the special skills of a trained neurologist.

MYASTHENIA GRAVIS

Sample of Neurologists:	Task Force conclusions:
15% consultative responsibility	100% consultation
84% primary responsibility	100% continuing care

Myasthenia gravis, a disease of the neuromuscular system for which there is adequate treatment, develops in about 800 people a year in the United States. At any given time there are about 8,000 people who suffer from it. The disorder itself is of great importance to the patient because it leads to double vision, trouble swallowing and talking and muscle weakness, any of which may completely handicap the patient and in certain instances lead to death. It is, thus, in addition to being of great distress to the patient, a disorder which makes him economically a cripple.

The diagnosis is dependent upon a neurologic examination and history and is confirmed by the use of neurologic tests such as the electromyogram. Treatment is difficult and requires considerable experience. It involves the use of drugs which in themselves may cause weakness. Therapy may often include the use of mechanical devices to aid respiration. In some patients, surgery may be the treatment of choice.

NEUROLOGIC MALFORMATIONS

Sample of Neurologists:	Task Force conclusions:
59% consultative responsibility	100% consultation
28% primary responsibility	25% continuing care

About 10,000 new cases of malformations of the nervous system appear annually in the United States. The care of a patient with such a malformation usually demands more than can be provided by one physician. The joint and collaborative efforts of several medical specialists are needed to set and plan the accomplishment of treatment goals and objectives to compensate for the defect. The neurologist's role involves extensive initial and follow-up diagnostic effort to define the nature, extent and, where possible, the cause of the malformation, associated neurological disturbances and genetic implications.

Throughout the period of growth the neurological defect may worsen because of changing relationships between the malformation and the residual nervous system. The neurologist's responsibility includes their detection, identification and treatment. The neurologist may additionally be responsible, working with other medical specialists, for the overall organization of the care program, coordination of special education efforts, advising parents and interpreting medical information to counsellors, school systems and community agencies. His most important contribution to the care of the child is often a holistic approach which ties the problems and programs together, viewing the child as a person who is a member of a family and a citizen in a community.

NON-CORRECTABLE VISUAL LOSS

Sample of Neurologists:	Task Force conclusions:
63% should be seen	15% consultation

This term refers to visual loss not related to the lens or cornea and therefore not remedied by eyeglasses or by cataract surgery. The defect may be inside the globe or retina and thus be visible to the ophthalmologist. However, when blindness is caused by disease affecting the optic nerves or their connections to the brain, the diagnostic problem becomes more complex. Such loss can be caused by brain tumor, stroke, infection or demyelinating disease within the skull or the brain itself. For this reason, a neurologist is asked to see about 15 percent of patients with "non-correctable" and undiagnosed visual loss.

OTHER PAIN PROBLEMS

Sample of Neurologists:	Task Force conclusions:
40% should be seen	67% consultation 33% continuing care

Pain is the number one symptom that causes patients to go to doctors. Persistent, unsolved pain problems are often referred to the neurologist, whose training in the psychology and neurophysiology of pain makes him a logical consultant. As a result, neurologists become familiar with a number of pain syndromes that fall between other specialty areas. Examples of such pain problems include atypical facial pain, trigeminal neuralgia, nerve root irritation (sometimes simulating organ diseases), "entrapment" syndromes in which a peripheral nerve is restricted by a tendon or ligament or an unyielding bony surface as in carpal tunnel syndrome, causalgia or painful consequences of injuries to nerves, the puzzle of pain referred to parts of the body remote from the site of disease and atypical migraine. Many of these pain syndromes, if properly diagnosed, can be treated successfully. In pain syndromes of obscure nature, it is often the neurologist who is equipped to initiate those investigations needed to elucidate the nature of the illness and provide the patient with continuing care and symptomatic relief.

PARKINSONISM

Sample of Neurologists:		Task Force conclusions:	
25%	consultative responsibility	100%	consultation
72%	primary responsibility	100%	continuing care

About 40,000 people annually develop Parkinson's disease in the United States and at any given time it is estimated that 400,000 suffer from the condition. Parkinsonism or paralysis agitans presents a broad spectrum of symptoms with slowness of movement, rigidity and tremor being the most prominent. Walking, balance, use of the hands and speech are usually affected. The impairment may be limited to one side of the body or generalized. The disorder may be mild or severe. It may progress rapidly or slowly or remain stabilized. In many instances the cause is unknown but in some a specific one may be uncovered.

The revolution in the quality of life of the parkinsonism patient following the discovery of L-Dopa and related drugs is one of the brightest chapters of modern neurology. Patients who formerly were unable to turn over in bed or attend to personal hygiene can walk, use the telephone, drive and work. The outlook for further progress in treating or preventing this disorder is promising. At the same time the treatment is complicated and for success requires intensive, skillful, individualized effort.

POLYMYOSITIS

Sample of Neurologists:		Task Force conclusions:	
40%	consultative responsibility	100%	consultation
54%	primary responsibility	100%	continuing care

Polymyositis, which affects about 12,000 people in the United States at any given time and strikes about 1,000 people annually, is a neuromuscular disorder which presents with weakness of the musculature associated with difficulty in swallowing and breathing. It usually progresses so that the patient is unable to work and he may become bedfast and eventually die of the disorder. Proper diagnosis is essential because in most instances the disease is curable.

Diagnosis is dependent upon an awareness of the symptoms, which requires a knowledge of the differential diagnosis of all the diseases which cause selective muscle weakness. The diagnosis is confirmed by a neurologic examination and history and it must usually be further verified by such tests as the electromyogram and muscle biopsy.

In most instances therapy is effective but it requires close observation and examination of the patient and is best carried out by a physician who has been trained in neurology.

RESIDUA OF SPINAL CORD INJURY

Sample of Neurologists:		Task Force conclusions:	
53%	consultative responsibility	100%	consultation
27%	primary responsibility	75%	continuing care

Approximately 100,000 survivors of spinal cord injury reside in the United States. Ten thousand are veterans and receive care in government facilities. The intermediate and late phases of spinal cord injury present a multiplicity of management problems, the crucial ones arising from the nervous system. Long-term care includes continued attention to the recovering motor and sensory systems and accommodation for their deficits by the prescription of appropriate appliances, the creation of new ones, the design of physical and vocational rehabilitation programs, the continual assessment of the neurological state and anticipating or recognizing complications affecting the nervous system. A principal function for the physician is the organization and direction of a team of medical and allied health specialists which views the whole patient and in collaboration with the patient establishes goals designed to restore him as closely as possible to independent self-sufficient living on terms of his own choice. The neurologist plays an important role in the education of the patient's family by helping teach them the needs of the injured person. While other medical specialties (orthopedics, plastic-neurosurgery) play important parts in the care program, the neurologist's training and background suit him to the key roles described above.

SEIZURES (CONVULSIONS, EPILEPSY, FITS)

Sample of Neurologists:	Task Force conclusions:
Questionnaire A	100% consultation
89% should be seen	67% continuing care
Questionnaire B	
26% consultative responsibility	
71% primary responsibility	

Convulsions, seizures and epilepsy are terms covering a group of common, serious and disabling neurologic conditions that affect about one million persons in the United States at a given time. Annually, about 80,000 people develop a convulsive disorder. Convulsions may be "idiopathic" (of unknown cause) but may also result from acquired physical causes which have to be identified by special neurologic studies. This is an area of medicine in which treatment is effective in about 85 percent of cases and most successfully treated patients can lead creative, productive lives.

A majority of patients with seizure states are best managed directly by the neurologist, who is most likely to keep informed on the changing picture in drug therapy and anticipate long-term complications of treatment that may occasionally arise; e.g., anemias, drug interactions and effects of drugs on cognitive and emotional states. Familiarity with the problems of seizure patients of all ages is essential for giving help in adjustment to the illness and answering questions related to heredity, marriage, pregnancy, education, driving licensure and insurance or for appropriate referral for such help. A minority may be cared for by their own physicians with neurologic consultation.

SYNCOPE

Sample of Neurologists:	Task Force conclusions:
48% should be seen	33% consultation
	15% continuing care

Syncope, the common faint, is one of the most frequent symptoms described by patients. It may be of great distress to the patient and his family. The loss of consciousness suggests the possibility of more serious disease and the symptom itself predicts to the patient and his family the possibility of death.

Although in most instances the symptom is not significant, syncope may be a sign of more serious disease which, if recognized early, may be treated to prevent the occurrence of death or disability. In approximately one-third of patients with syncope the exact etiology is not clear to the initial examining physician. In these patients it is essential that neurologic causes for syncope should be evaluated and, if present, properly treated. Syncope may be a sign of impaired cerebral blood flow, as in transient ischemic attacks and orthostatic hypotension, or it may be a sign of a seizure disorder, as in brain tumor. The differential diagnosis of syncope is dependent upon a knowledge of the neurologic causes of this disorder and is, in most instances, dependent on eliciting a complete history and carrying out a complete neurologic evaluation, perhaps including the use of such specialized neurologic techniques as the electroencephalogram, electromyogram and angiography.

Proper therapy depends upon the diagnosis. When such neurologic diagnoses as brain tumor, transient ischemic attacks or orthostatic hypotension are made, the proper therapy will be neurologic and is best carried out by a physician who has had specialized training in this area.

TRANSIENT ISCHEMIC ATTACKS

Sample of Neurologists:	Task Force conclusions:
29% consultative responsibility	100% consultation
67% primary responsibility	100% continuing care

About 60,000 people annually experience transient ischemic attacks in the United States. A transient ischemic attack is one in which a period of weakness, numbness, loss of speech or reduced vision lasting less than a few hours results from impaired brain circulation. Attacks may occur singly or in clusters. The patient seems completely well between attacks. It is widely believed that transient ischemic attacks foreshadow strokes. It is in this group of patients, therefore, that the most effective stroke prevention will result.

The neurologist's role is to identify and treat conditions causing transient ischemic attacks and to ascertain that the attacks really result from impaired circulation. This often requires specialized examining techniques and the performance of complicated diagnostic procedures. Since some of these carry the risk of added obstruction to brain circulation, expert judgment is needed in deciding on their use.

VERTIGO

Sample of Neurologists:	Task Force conclusions:
60% should be seen	Not given

Vertigo is that condition characterized by an hallucination of movement, usually spinning or whirling. It is the result of a disease process affecting the balancing organ in the inner ear or its connections to and within the central nervous system. Vertigo is always distressing, often of abrupt onset, associated with severe nausea and retching and extremely disabling to the terrified patient. Attacks may last hours to days. The cause of vertigo may be readily apparent. However, at least half of the patients require neurologic investigation to separate "benign" vertigo from that caused by vascular disease, multiple sclerosis or other central nervous system disease.

Appendix VIII

Current Needs for Neurological Manpower

The material which follows was prepared by a subcommittee of the Task Force on Neurological Services of the Joint Commission on Neurology under the chairmanship of John F. Kurtzke, M.D., of Georgetown University and the Veteran's Administration Hospital, Washington D.C. This material includes 24 tables, the first 22 of which deal with the epidemiology of specific neurologic disorders, the last two of which summarize the calculations carried out to determine the current need of neurological manpower.

The epidemiological data were derived from a variety of sources, among them the study "Source of Referral, Presenting Complaint and Diagnoses in Neurological Practice" carried out by the Joint Commission, but primarily from *The Epidemiology of Neurologic and Sense Organ Disorders* by Drs. Kurtzke, Kurland and Goldberg and a paper "The Epidemiology of Neurologic Disease" By Dr. Kurtzke and Dr. Kurland included in *Clinical Neurology* by A. B. Baker.

The calculation of nuerological manpower needs reflects a combination of the epidemiological data with Task Force judgements as to the standards of optimal care for neurological disorders. Specifically, the need for neurologist man hours per year for each of 39 neurologic diseases and symptoms was calculated (Table 23) using the following information for each condition, as appropriate:

1. Average duration of the condition (derived from incidence and prevalence data and providing an estimate of the number of patients carried over from year to year);
2. Annual incidence (number of new cases to be expected per year in a population of 200 million people with an age distribution equal to that of the United States in 1960);
3. Proportion of such patients to be seen at least once by a neurologist (consensual judgement of the Task Force);
4. Number of hours required per year for care by neurologists of patients in (3) above (consensual judgement of the Task Force);
5. Proportion of such patients who require continuing care by a neurologist (consensual jdugement of the Task Force);
6. Number of hours required per year for care by neurologists of patients in (5) above (consensual judgement of the Task Force).

(The stages in the calculation are given in Table 23.)

The annual incidence of new cases expected per year for the specified 39 entities totals 1.6 percent of the population (3.1 million people), of whom 71 percent (2.2 million people or 1.1 percent of the population) should, in the judgement of the Task Force, be seen at least once by a neurologist for diagnosis or treatment.

The total number of hours required for neurologists to care for each of the 39 groups of patients is presented in Table 24. This is divided into those necessary for "acute" care (essentially, the total number of hours needed for the initial diagnosis or treatment) and those necessary for "chronic" or continuing care during each year.

"Acute" care for patients suffering from the 39 specified neurologic disorders would require 4.5 million neurologist hours annually in a country of 200 million people. "Chronic" care would require an additional 8.3 million neurologist hours. The total of the two (12.7+ million hours) represents care only for these 39 entities. On the basis of the Joint Commission study "Source of Referral, Presenting

Complaint and Final Diagnoses," it was calculated that these 39 entities represent approximately 74 percent of the diagnoses among patients seen by neurologists. Again assuming optimal patterns of screening and care, it was calculated that neurologists would need 17.3 million man-hours per annum (6.1 million for "acute" care and 11.2 million for "chronic" care) to care for a population of 200 million. If each neurologist were to devote 50 hours a week and 50 weeks a year entirely to patient care, this would entail some 6,900 neurologists. If neurologists were to devote 35 hours per week to direct patient care, then the need would be for 9,900 neurologists in practice if ideal or optimal care, as defined by the Task Force, is to be the standard.

As of 1971, if all residents in training, researchers, administrators and retirees (but not those neurologists who describe their primary professional activity as teaching) are subtracted from the total of 3,398 neurologists in the United States, there are 2,748 neurologists available for patient care. If these 2,748 neurologists devoted 50 hours a week for 48 weeks a year to direct patient care, they could provide 6,595,000 neurologist hours, sufficient for the screening and care of all the "acute" needs and about 5 percent of the "chronic" needs as defined by the Task Force. If it is assumed that 182 "teachers" do not provide any patient care, then the pool available would be sufficient to provide screening and care for all the "acute" needs but only 1 percent of chronic needs (assuming a 50-hour-week and a 48-week year).

TABLE 1

New Cases of Selected Neurologic Disorders Each Year in United States Population of 200 Million

Herpes zoster		800,000
CVD:		400,000
Subarachnoid hemorrhage	40,000	
Cerebral hemorrhage	60,000	
Cerebral thrombosis	240,000	
Cerebral embolism	20,000	
Other CVD	40,000	
Convulsive Disorders:		80,000
Primary grand mal	24,000	
Petit mal alone	6,000	
Secondary fits	50,000	
Transient ischemic attack		60,000
Bell's Palsy		40,000
Parkinson's disease		40,000
Primary Brain Tumor		20,000
Gliomas	10,000	
Meningiomas	4,000	
Pituitary	2,000	
Other brain tumor	4,000	
Trigeminal neuralgia		8,000
Dorsolateral sclerosis		6,000
Multiple sclerosis		4,000
Tumor, peripheral nervous system		4,000
Guillain-Barré syndrome		2,000
Motor neuron disease		2,000
Primary spinal cord tumor		[illegible]
Polymyositis		[illegible]
Huntington's chorea		1,000
Myasthenia gravis		800
Syringomyelia		600
Wilson's disease		400

Source: Kurtzke, John F., and Kurland, L. T. (1973): The Epidemiology of Neurologic Disease. In: *Clinical Neurology*, (ed) A. B. Baker, Harper and Row, New York.

TABLE 2

Estimates from Other Available Sources of New Cases of selected Neurologic Disorders Each Year in United States Population of 200 Million

(see Table 3)

Severe head injury	400,000
Radiculopathies	260,000
Noticeable deafness	200,000
Mononeuropathies	100,000
Polyneuropathies	80,000
Severe (hospitalized) organic brain syndrome	80,000
(Legal) blindness	30,000
Meningitis	20,000
Severe mental retardation	14,000
Severe spinal cord injury	4,000
Encephalitis	2,000
Other infections	2,000

TABLE 3

Estimated Incidence Rates per 100,000 Population for Selected Neurologic Disorders*

Disorder	Rate
Severe head injury (Table 7)	200
Radiculopathies (Table 8)	130
Noticeable deafness (Table 9)	100
Mononeuropathies (Table 8)	50
Polyneuropathies (Table 8)	40
Severe (hospitalized) organic brain syndrome (Table 11)	40
(Legal) blindness (Table 12)	15
Metastatic brain tumor**	10
Meningitis (*** and Table 16, 17)	10
Severe mental retardation (Table 11, 18)	7
Severe spinal cord injury****	2
Encephalitis (Table 16)	1
Other infections (Table 16)	1
Approximate total	600/100,000

* Estimates by Kurtzke, J. F., and Kurland, L. T., based on tables cited.

** From ratio of metastatic to primary brain tumors from hospital data.

*** Fraser, D. W., Henke, C. E., Feldman, R. A.: Changing Patterns of Bacterial Meningitis in Olmsted County, Minnesota, 1935–1970. In: *Mayo Clinic data* (in preparation).

**** Smittkamp, J. (1967): Estimates: Prevalence, Annual Incidence and Increment, Statistical Characteristics, and Cost of Paraplegia. In: *Paraplegia Workshop*, (ed) Bering, E., pp. 11–16.

TABLE 4

Cases of Selected Neurologic Disorders Present at Given Time in United States Population of 200 Million

Cerebrovascular disease	1,000,000
Convulsive disorders	1,000,000
Parkinsonism	400,000
Cerebral palsy	120,000
Multiple sclerosis	100,000
Primary brain tumor	80,000
Dorsolateral sclerosis	40,000
Primary spinal cord tumor	20,000
Syringomyelia	16,000
Muscular dystrophy	[illegible]2,000
Polymyositis	12,000
Huntington's chorea	12,000
Motor neuron disease	10,000
Charcot-Marie-Tooth disease	10,000
Hereditary ataxias	8,000
Myasthenia gravis	8,000
Myotonic dystrophy	4,000
Wilson's disease	2,000
Dystonia musculorum deformans	600

Source: Kurtzke, John F., and Kurland, L. T. (1973): The Epidemiology of Neurologic Disease. In: *Clinical Neurology*, (ed) A. B. Baker, Harper and Row, New York.

TABLE 5

Estimates from Other Available Sources for Neurologic Cases Present at a Given Time in United States Population of 200 Million

(see Table 6)

Noticeable binaural hearing loss		4,000,000
Binaural deafness	(800,000)	
Prelingual deafness	(140,000)	
"Head injury"		3,000,000
Mental retardation		2,000,000
Severe mental retardation	(200,000)	
Severe migraine*		1,000,000
(Legal) blindness		300,000
Spinal cord injury		100,000
Severe organic brain syndrome		50,000

* Requiring medical attention.

TABLE 6

Estimated Prevalence Rates per 100,000 Population for Selected Neurologic Disorders*

Disorder	Rate
Noticeable binaural hearing loss (Table 10, 19)	2,000
(Binaural deafness) (Table 19)	(400)
(Prelingual deafness)**	(70)
"Head injury" ***	1,500
Mental retardation (Table 18)	1,000
(Severe Mental retardation) (Table 18)	(100)
Severe migraine requiring medical attention (Table 20)	500
(Legal) blindness (Table 13, 15)	150
Severe spinal cord injury****	50
Severe (hospitalized) organic brain syndrome (Table 23)	45
Approximate total: 5,200/100,000 or 5% of population	

* Estimates by Kutzke, J. F., and Kurland, L. T., based on tables cited.

** Schein, J. D.: Hearing Disorders (1973). In: *Epidemiology of Neurologic and Sense Organ Disorders*, (eds) Kurland, L. T., Kurtzke, J. F., and Goldberg, L. G., pp. 276–304, Harvard University Press, Cambridge.

*** Office of the Director, NINDS (1971): Accident Head and Spinal Cord Injury, USDHEW, NIH.

**** Smittkamp, J. (1967): Estimates: Prevalence, Annual Incidence and Increment, Statistical Characteristics, and Cost of Paraplegia. In: *Paraplegia Workshop*, (ed) Bering, E., pp. 11–16, NINDS, NIH.

TABLE 7

Severe Head Injury: Average Annual Incidence Rates per 100,000 Population

Place	Period	Rate	M:F Ratio
Newcastle-on-Tyne [a]	1963–64	97	4:1
Brisbane, Australia [b]	1956–67	147	4:1
U.S. insurance employees [c]	1965–67	230M	
	1970–71	340F	0.7:1
Sacramento, California [d]		188	—
U.S. Health Interview Survey [e]	1965–67	415M	
		355F	1.24:1

— No information.

[a] Hospitalized patients, calculated from data of Craft et al. (BMJ 4:200, 1972) δ. Kerr et al. (*BJ Prev. Soc. M.25*:179, 1971).

[b] Hospitalized patients, from data of Jamieson & Kelland (*J. Neurosurg. 37*:150, 1972).

[c] "Injuries to skull, spine or trunk," with over 7 days disability, from Metropolitan Life Ins. Co., *Stat. Bull.* August 1970, p. 7.

[d] "Fracture skull" + "Intracranial injury," Sacramento Foundation report July 26, 1971.

[e] "Skull fracture or head injury," requiring restriction to bed (an average of 1.9 days), National Center for Health Statistics, Series 10, No. 57, October 1969.

TABLE 8

Neuropathies: Average Annual Incidence Rates per 100,000 Population, Rochester, Minn. 1950–54

(provisional data) [*]

	Total		Male		Female	
Polyneuropathies	36.8		60.0		18.8	
alcoholic		2.8		1.6		3.8
with DLS		1.4		3.2		—
diabetic		19.1		34.1		7.5
cause unknown		13.5		21.1		7.5
Mononeuropathies**	49.6		82.7		23.9	
traumatic		14.9		22.7		8.8
compression		2.8		3.2		2.5
ischemic		7.1		8.1		6.3
cause unknown		24.8		48.7		6.3
Radiculopathies	129.6		142.8		119.3	
cervical		15.6		16.2		15.1
thoracic		3.5		8.1		—
lumbar		110.5		118.4		104.3
compression/ spondylosis		(7.8)		(13.0)		(3.8)
HNP		(10.6)		(8.1)		(12.6)
HNP-sciatica		(85.0)		(97.3)		(75.4)
cause unknown		(7.1)		—		(12.6)
Thoracic outlet	12.0		4.9		17.6	

[*] Kurtzke, J. F. and Kurland, L. T., Neuropathies in Rochester, Minnesota (unpublished data).

[**] Single/multiple.

— No cases.

TABLE 9

Annual Incidence per 100,000 Population for Noticeable Deafness

U.S. Population 1960 (× 100,000)		> 15 db		> 35 db[1]	
Age	N	Rate	N	Rate	N
< 20	690.0	40	27,600	20	13,800
20–29	216.7	50	10,835	—	—
30–39	244.3	160	39,088	30	7,329
40–49	224.8	150	33,720	30	6,744
50–59	160.4	600	96,240	100	16,040
60–69	134.0	1,800	241,200	600	80,400
70+	95.6	2,100	200,760	500	47,800
	1765.8	368	649,443	97.5	172,113

97.5 = 100/100,000 for noticeable deafness.

Rounded 2000 prevalence compared to 100 incidence = about 20-year-average duration.

[1] Noticeable deafness = 35 db loss or more.

— No cases.

TABLE 10

Estimation of Annual Incidence Rates for Noticeable Deafness from Prevalence Rates for Same

(Prevalence per 100,000 Population, Better Ear, U.S. 1960–62: HES[1] adapted from Schein, 1973)

Age	> 15 db	> 35 db[3]	Estimated Incidence[2]		
			Age	> 15 db	> 35 db[3]
18–79	4000	1900	all[4]	~ 370	~ 100
			< 20[4]	(800/20) = 40	(400/20) = 20
18–24[4]	770	410	20–29	(500/10) = 50	—
25–34	1290	380	30–39	(1600/10) = 160	(300/10) = 30
35–44	2870	700	40–49	(1500/10) = 150	(300/10) = 30
45–54	4360	1000	50–59	(6000/10) = 600	(1000/10) = 100
55–64	10350	1990	60–69	(18000/10) = 1800	(6000/10) = 600
65–74	28220	7930	70+[4]	(21000/10) = 2100	(5000/10) = 500
75–79[4]	49030	13270			

[1] HES = Health Examination Survey
HIS = Health Interview Survey

[2] Age—Specific incidence approximated from difference between age-specific prevalences divided by number of years in age-class.

[3] Noticeable deafness = 35 db loss or more.

[4] 18–24 HES rate is close to < 17 HIS rate (any hearing impairment 770 vs 810; or 410 vs 350 bilateral) and 65+ HIS is close to 75–79 HES (tbl. [illegible].6, [illegible] and. Kurtzke and Goldberg, *op. cit.*) and thus these estimates can be used for < 20 and 70+.

— No cases.

TABLE 11

Approximate "Incidence" per 100,000 Population for Organic Brain Syndrome (U.S. 1970) Based on Total Additions to United States Public and Private Mental Hospitals

Total OBS	35.7	
OBS—ETOH		11.0
OBS—lues		0.5–
OBS—drug/poison		1.8
OBS—arteriosclerosis/senility		14.5–
OBS—other		8.0
Mental Retardation	6.4	
Total psychiatric patients	270.1	

Source: NIMH—NINDS, HEW statistics, courtesy I. D. Goldberg, NIMH.

TABLE 12

Blindness:[1] Age, Sex & Color—Specific Incidence Rates (U.S. 1966) MRA[2]

Age	Total			White			Non-white		
	T	M	F	T	M	F	T	M	F
All Ages	15	14	16	13	12	14	22	21	24
< 5	4	5	3	—	—	—	—	—	—
5–19	5	6	4	4	5	4	6	6	6
20–44	5	6	4	4	5	4	10	10	9
45–64	19	19	18	15	16	14	51	48	54
65–74	42	39	44	35	33	36	97	85	107
75–84	138	128	145	127	119	133	206	179	229
85+	342	318	354	330	297	349	—	—	—

— No information.

[1] Maximal acuity 20/200 or less, or VF 20° diameter or less, in better eye.

[2] Model Reporting Area (MRA) data from 15 or 16 states.

Source: Adapted from Goldstein, H.: Blindness (1973). In: *Epidemiology of Neurologic and Sense Organ Disorders*, (eds) Kurland, L. T., Kurtzke, J. F., Goldberg, I. D., pp. 246–275, Harvard University Press, Cambridge.

TABLE 13

Annual Incidence and Point Prevalence Rates per 100,000 Population for (Legal) Blindness in United States 1966 (MRA) Data

Color & Sex	Incidence	Prevalence
Total	15	147
Male	14	148
Female	16	146
White	13	126
Male	12	126
Female	14	126
Nonwhite	22	241
Male	21	251
Female	24	232

Source: Adapted from Goldstein, H.: Blindness (1973). In: *Epidemiology of Neurologic and Sense Organ Disorders*, (eds) Kurland, L. T., Kurtzke, J. F., Goldberg, I. D., pp. 246–275, Harvard University Press, Cambridge.

TABLE 14

BLINDNESS

Groups of "Cause" and "Affections" for Incident Cases, U.S. 1966—MRA (percentage frequencies)

	Total	Major Affection Groups						
		GL	Cataract	Ret. Deg	Other Ret.	O.A.	Multiple Affections	All Others
Major Cause	Total: 100	11	19	19	15	5	9	22
diabetes	12	—	—	—	10	0	2	0
senile degen.	33	—	16	14	1	—	3	0
"prenatal infl."	14	—	2	4	0	1	—	7
"unknown to science"	12	11	—	0	0	—	—	0
not rept/deter.	14	—	1	1	2	2	0	9
all others	16	—	1	0	2	2	5	6

— No cases, 0 = < 0.5%.
GL = glaucoma; Ret. Deg. = retinal degeneration; Other Ret. = other retinal affections; OA = optic atrophy.

TABLE 15

Blindness: "Prevalence" per 100,000 by Age, Sex, Color (U.S. 1966—MRA)

Age	Total			White			Non-White		
	T	M	F	T	M	F	T	M	F
Total	147	148	146	126	126	126	241	251	232
< 5	8	8	8	—	—	—	—	—	—
5–19	53	58	47	48	53	43	55	63	47
20–44	74	88	60	64	77	50	138	160	118
45–64	205	231	181	156	179	134	568	622	518
65–74	418	438	402	331	344	320	1110	1153	1074
75–84	956	902	995	858	808	894	1724	1576	1848
85+	2935	2581	3127	2803	2419	3006	—	—	—

— No information.

TABLE 16

Infections of Nervous System: Reported Average Annual Incidence and Death Rates per 100,000 Population, United States

	1968–1972	1964–1968		1959–1961	
	Incidence [a]	Incidence [a]	Death [a]	Incidence [b]	Death [b]
Aseptic meningitis	2.37	1.56	—	—	0.02[c]
Meningococcal infection	1.15	1.45–	0.40	1.24	0.36
TB meningitis [d]	—	—	—	—	0.12
Meningitis, other purulent	—	—	1.13	—	1.26
Botulism	0.01	0.01	0.002	0.01	0.01
Primary encephalitis	0.75	0.94	0.25	—	0.30
Post-infectious encephalitis	0.19	0.53	—	—	—
Leprosy	0.06	0.05	0.002	0.03	0.00
Paralytic poliomyelitis	0.01	0.04	0.01	1.82	0.14
Rabies	0.001	0.001	0.001	0.002	0.00
Tetanus	0.07	0.13	0.08	0.22	0.14
Trichinosis	0.06	0.07	0.01	0.13	—
(New reported) lues [e]	(47.22)	(54.86)	(1.06)	(69.0)	(1.6)
GPI	—	—	0.06[f]	—	0.1
Other CNS syphilis	—	—	0.10	—	—
Intracranial/spinal abscess	—	—	—	—	0.16

[a] CDC: *Morbidity & Mortality 20:* Annual Supplement: Summary 1971, and ibid., *21:*445–456 Dec. 30, 1972 unless otherwise cited.

[b] Dauer, C. C., Korns, R. F., Schuman, L. M.: *Infectious Diseases*, Harvard University Press, Cambridge, 1968 unless otherwise cited.

[c] Lymphocytic choriomeningitis.

[d] Lowell, A. M., Edwards, L. B., Palmer, C. E.: *Tuberculous Morbidity & Mortality and its Control*, Harvard University Press, Cambridge, 1969.

[e] Brown, W. J., Donohue, J. F., Axnick, N. W., Blount, J. H., Ewen, N. H., Jones, O. G.: *Syphilis and Other Venereal Diseases*, Harvard University Press, Cambridge, 1970.

[f] 1963: 0.0 for GPI and for tabes in 1965; unpublished data.

— No information.

TABLE 17

Meningococcal Meningitis: Average Annual Incidence Rates per 100,000 Population in Selected Countries and Intervals

Are	Period	Rate
Denmark	1921–30	3.1
''	1932–40	1.7
''	1941–45	8.7
''	1946–50	6.5
''	1950	3.8
''	1961	2.0
Norway	1946	6.1
''	1961	0.8
Sweden	1961	1.5
''	1962	2.4
Finland	1950	2.2
''	1960	2.4
''	1964	1.3
Switzerland	1955	2.1
''	1961	1.0
''	1962	2.1
Carlisle, England	1955–61	2.1
U.S.A.	1959–61	1.2
''	1964–68	1.4
''	1968–72	1.1

Source: Appropriate statistical year books.

TABLE 18 (A)

Mental Retardation: Prevalence Rates per 100,000 Population

Severe (hospitalized)	Rate	
U.S. 1960–1964 (Heber '70)	94	(M 104, F 82)
U.S. 1970 (NIMH)	(15)	
All degrees (population estimates)		
Britain 1925–1927 (Lewis '29)	860	
Baltimore 1933–1936 (Lemkau '42)	1220	
Onondaga 1953 (N.Y. State '55)	3520[a]	
Onondaga 1953 [IQ < 75]	1410[a]	
U.S. World War II rejectees (Ginzberg, Bray '53)	4000[b]	

[a] Under age 18, includes "suspects."

[b] Age 18–37, evaluations questionable.

TABLE 18 (B)

Severe Mental Retardation: Incidence Rates per 100,000 Population for Hospital Admissions

	Total	Male	Female
U.S. 1960–1964 (Heber '70)	7	8	6
U.S. 1970 (NIMH)	6	8	5

Sources: Heber, R.: *Epidemiology of Mental Retardation*, Charles C Thomas, Springfield, Illinois, 1970.

NIMH data courtesy of I. D. Goldberg, NIMH.

Lewis, E. O.: *Report on Investigation into the Incidence of Mental Deficiency in Six Areas, 1925–1927*, London, HMSO, 1929.

Lemkau, P., Tietze, C., Cooper, M.: "Mental-hygiene Problems in an Urban District," *Mental Hygiene*, 26:275, 1942.

Mental Health Research Unit: "Technical Report, Onondaga County, Syracuse, New York," N.Y. State Department of Mental Hygiene, 1955.

Ginzberg, E., Bray, D. W.: *The Uneducated*, New York, Columbia University Press, 1953.

TABLE 19

Binaural Hearing Impairment: Estimates of Prevalence Rates per 100,000 Population by Degree and Sex, United States

Approximate Loss (better ear)	Total	Male	Female
> 15 dB [a]	7310	7600	7100
> 30 dB [b]	2230	2550	1930
> 65 dB [a]	415	400	400
> 65 dB [b]	470	470	460

[a] Health Examination Survey, age 18–79 only, 1960–1962.

[b] Health Interview Survey, all ages, 1962–3.

(30 dB = level for impaired hearing of normal speech).

Source: Adapted from Schein, J. D., "Hearing Disorders" (Chapter 13), in Kurland, L. T., Kurtzke, J. F., Goldberg, I. D.: *Epidemiology of Neurologic and Sense Organ Disorders*, Harvard University Press, Cambridge, 1973, pp. 276–304.

TABLE 20

Migraine: Prevalence Rates per 1,000 Population

Source	Period	Male	Female	Total
English General Practices [a]	1955–56	3	8	5
Carlisle, England [b]	1955–61	—	—	5
Carlisle household survey [b]	1961	19[1]	52[1]	36[1]
Backenham, Kent practice [c]	ad1962	[30]	[70]	50
Glamorgan, Wales survey [d]	1969 approx.	[90][2]	190[2]	[140][2]
Copenhagen survey [e]	1967–68	68[3]	74[3]	71[3]
Copenhagen estimate [e]	—	112[1,4]	188[1,4]	[150][1,4]

[1] Lifelong prevalence.

[2] Age 20-64 estimates.

[3] Age 7–18.

[4] Calculated "maximum likelihood estimates."

[ ] Rates calculated from data presented.

— No information.

[a] Logan, W. P. D., Cushion, A. A.: "Studies on Medical and Population Subjects," No. 14, Morbidity Statistics from General Practice, vol. 1 (General), H.M.S.O., London, 1958.

[b] Brewis, M., Poskanzer, D. C., Rolland, C., Miller, H.: "Neurological Disease in an English City," *Acta Neurol. Scand. 42* (suppl. 24): 1966.

[c] Fry, J.: "Minor Maladies," *The Practitioner 189*:633–40, 1962.

[d] Waters, W. E., O'Connor, P. J.: "Epidemiology of Headache and Migraine in Women," *J. Neurol. Neurosurg. Psych. 34*:148–153, 1971; also, Waters, W. E.: *BMJ 1*:142–43, 1971 and *BMJ 2*:77–81, 1971.

[e] Dalsgaard-Nielsen, T., Engberg-Pedersen, H., Holm, H. E.: "Clinical and Statistical Investigations of the Epidemiology of Migraine," *Danish Med. Bull 17*:138–148, 1970.

TABLE 21

Migraine: Sex and Age—Specific Prevalence Rates per 1,000 Population

English G.P.[a]			Carlisle[1] household survey[b]			Beckenham, Kent practice[c]			Copenhagen[d] (cumulative) max. likelihood est.		
Age	M	F	Age	M	F	Age	M	F	Age	M	F
									7–9	31	28
0–14	2	2	3–17	13	15	10–19	7	6	9–11	45	43
15–44	4	11	18–32	24	60	20–29	16	37	11–13	60	60
45–64	3	10	33–47	23	80	30–39	55	89	13–15	73	77
65+	1	2	48–62	17	63	40–49	44	125	15–17	84	95
			63+	16	38	50–59	15	86	17–19	94	112
						60+	—	12	19–21	100	128
									21–25	106	147
Total	3	8	Total	18	48	Total	[30]	[70]	25–30	110	167
									30–35	112	180
									35–40	112	185
									40+	112	188

[a] Logan & Cushion.

[b] Brewis et al.

[c] Fry.

[d] Dalsgaard-Nielsen et al.

[1] Lifelong.

[ ] Calculated.

— No information.

TABLE 22

Approximate "Prevalence" per 100,000 Population for Organic Brain Syndrome Based on Resident Patients at End of Year in United States—Public (1970), Private (1969) and V.A. (1970) Mental Hospitals

Total OBS	45.1		Less Private	44.1	
OBS—ETOH		6.5			6.3
OBS—lues		—			3.5
OBS—drug/poison		—			0.3
OBS—AS/senility		—			21.8
OBS—other		—			12.2
Mental Retardation	15.0			14.9	
Total psychiatric patients	192.6			187.2	

— No information.
Source: NIMH—NINDS, HEW statistics courtesy of I. D. Goldberg, NIMH.

TABLE 23.—Calculations for Estimating Neurologist-hours per Annum

Disease or symptoms *	Av. durat. (yrs.)	No. of estimated cases in the country Incidence	Estimated cases to be seen at least once by the neurologist for diagnosis with or without treatment		No. of hours necessary per yr. for these cases to be seen by the neurologist	
					hrs./case	F = D × E
(A)	(B)	(C)	p	(D)	(E)	(F)
Dementia, severe	1.2	80,000	1.0	80,000	3	240,000
Spinal cord injury	25	4,000	1.0	4,000	20	80,000
Convulsive disorder	12.5	80,000	1.0	80,000	1	80,000
CVD-acute	(2.5)	400,000	1.0	400,000	2	800,000
CVD-chronic	(2.5)	**[1,000,000] prev.	3/4	[750,000] prev.	1/2	375,000
TIA	abt. 2	60,000	1.0	60,000	2	120,000
Dystrophies	16	1,000	1.0	1,000	4	4,000
Polymyositis	12	1,000	1.0	1,000	4	4,000
M.G.	10	800	1.0	800	3	2,400
Guillain Barre	—	2,000	1.0	2,000	15	30,000
M.S.	25	4,000	1.0	4,000	5	20,000
A.L.S. (MND)	5	2,000	1.0	2,000	4	8,000
Meningitis	—	20,000	1.0	20,000	8	160,000
Encephalitis & other infex.	—	4,000	1.0	4,000	8	32,000
BT (1°)	4	20,000	1.0	20,000	4	80,000
Met. BT	1	20,000	1.0	20,000	4	80,000
Mental Ret. (severe)	14	14,000	0.5	7,000	3	21,000
CP	20	6,000	3/4	4,500	2	9,000
Malform. NS	—	10,000	1.0	10,000	1/2	5,000
Acute head trauma (severe)	—	400,000	1.0	400,000	2	800,000
Parkinson's	10	40,000	1.0	40,000	1	40,000
Huntington's Chorea	12	1,000	1.0	1,000	2	2,000
Migraine (severe)	5	200,000	1.0	200,000	1	200,000
Spinal cord tumor	10	2,000	1.0	2,000	4	8,000
Dorsolateral sclerosis	7	6,000	1.0	6,000	2	12,000
Syringomyelia	27	600	1.0	600	2	1,200
Wilson's dis.	5	400	1.0	400	2	800
C.M.T.	50	200	1.0	200	2	400
Hereditary ataxias	20	400	1.0	400	2	800
D.M.D.	5	100	1.0	100	2	200
Bell's palsy	—	40,000	1.0	40,000	1/2	20,000
Trigeminal neuralgia	—	8,000	1.0	8,000	1	8,000
Herpes zoster	—	800,000	1/4	200,000	1/2	100,000
Tumor peripheral NS	—	4,000	0.5	2,000	1	2,000
Polyneuropathies	—	80,000	1.0	80,000	2	160,000
Mononeuropathies	—	100,000	1.0	100,000	1	100,000
Radiculopathies (incl. HNP)	3	260,000	1.0	260,000	2	520,000
(Legal) blind.	10	30,000	1/6	5,000	3	15,000
Noticeable deafness	20	200,000	1/6	33,000	2	67,000
Chronic non-vascular headache	—	200,000	2/3	133,000	2	267,000
Total		3,101,500 = 1.55%		2,232,000 = 1.12%		4,474,800

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* No data were available on the following conditions: lipidoses, vertigo, alcoholism, faints, drug toxicity, metabolic disorders, collagen diseases, psychoses and psychoneuroses.

** Not included in total.

No. of cases to be under the care of the neurologist after the acute illness		Estimated hours necessary for this type of care			Total no. of hours per year for care of these patients
	H = G × C	hrs/case/yr.	J = I × H	K = J × B	L = K + F
p (G)	(H)	(I)	(J)	(K)	(L)
1/4	20,000	2	40,000	48,000	288,000
1.0	4,000	4	16,000	400,000	480,000
2/3	53,000	1	53,000	662,500	742,500
2/3	267,000	10	2,670,000	←	3,470,000
1/4	250,000	2	500,000	←	875,000
1.0	60,000	2	120,000	240,000	360,000
1.0	1,000	1	1,000	16,000	20,000
1.0	1,000	6	6,000	72,000	76,000
1.0	800	8	6,400	64,000	66,400
1.0	(2,000)	←	←	←	30,000
1.0	4,000	1½	6,000	150,000	170,000
1.0	2,000	3	6,000	30,000	38,000
1.0	(20,000)	←	←		160,000
1.0	(4,000)	←	←		32,000
1.0	20,000	3	60,000	240,000	320,000
1.0	20,000	3	60,000	60,000	140,000
1/6	2,300	1	2,300	32,200	53,200
1/4	1,500	2	3,000	60,000	69,000
1/4	2,500	1	2,500	←	7,500
1.0	400,000	1/2	200,000	←	1,000,000
3/4	30,000	2	60,000	600,000	640,000
1.0	1,000	1	1,000	12,000	14,000
1/2	100,000	2	200,000	1,000,000	1,200,000
1.0	2,000	4	8,000	80,000	88,000
1/3	2,000	2	4,000	28,000	40,000
1.0	600	1	600	16,200	17,400
1.0	400	4	1,600	8,000	8,800
1.0	200	1/2	100	5,000	5,400
1.0	400	1/2	200	4,000	4,800
1.0	100	2	200	1,000	1,200
1/4	10,000	1/2	5,000	←	25,000
1.0	8,000	3	24,000	←	32,000
1/10	80,000	1/4	20,000	←	120,000
1.0	1,000	1/2	500	←	2,500
1.0	80,000	1	80,000	←	240,000
1.0	100,000	1	100,000	←	200,000
3/4	195,000	1	195,000	585,000	1,105,000
1/20	1,500	1	1,500	15,000	30,000
1/20	10,000	1	10,000	200,000	267,000
1/10	20,000	2	40,000	←	307,000
	1,777,300 = 0.89%				12,745,700

TABLE 24

Neurologist-hours per Annum Required for Care of Patients with Selected Neurologic Disorders in a United States Population of 200 Million

Disorder	Figures from Table 23		
	"Acute" (F)	"Chronic" (K)	Total (L)
Cerebrovascular disease—			
Acute	800,000	2,670,000	3,470,000
Chronic	375,000	500,000	875,000
Transient ischemic attack	120,000	240,000	360,000
Acute severe head trauma	800,000	200,000	1,000,000
Radiculopathies (+HNP)	520,000	585,000	1,105,000
Chronic non-vascular headache	267,000	40,000	307,000
Severe dementia	240,000	48,000	288,000
Severe migraine	200,000	1,000,000	1,200,000
Meningitis	160,000	—	160,000
Polyneuropathies	160,000	80,000	240,000
Mononeuropathies	100,000	100,000	200,000
Herpes zoster	100,000	20,000	120,000
Spinal cord injury	80,000	400,000	480,000
Convulsive disorders	80,000	662,500	742,500
Primary brain tumor	80,000	240,000	320,000
Metastatic brain tumor	80,000	60,000	140,000
Noticeable deafness	67,000	200,000	267,000
Parkinson's disease	40,000	600,000	640,000
Encephalitis et al.	32,000	—	32,000
Guillain Barre syndrome	30,000	—	30,000
Severe mental retardation	21,000	32,200	53,200
Multiple sclerosis	20,000	150,000	170,000
Bell's palsy	20,000	5,000	25,000
(Legal) blindness	15,000	15,000	30,000
Dorsolateral sclerosis	12,000	28,000	40,000
Celebral palsy	9,000	60,000	69,000
Amyotrophic lateral sclerosis & Motor neuron disease	8,000	30,000	38,000
Spinal cord tumor	8,000	80,000	88,000
Trigeminal neuralgia	8,000	24,000	32,000
Malformations, nervous system	5,000	2,500	7,500
Dystrophies	4,000	16,000	20,000
Polymyositis	4,000	72,000	76,000
Myasthenia gravis	2,400	64,000	66,400
Huntington's chorea	2,000	12,000	14,000
Tumor peripheral nervous system	2,000	500	2,500
Syringomyelia	1,200	16,200	17,400
Wilson's disease	800	8,000	8,800
Charcot-Marie-Tooth disease	400	5,000	5,400
Dystonia musculorum deformans	200	1,000	1,200
Hereditary ataxias	800	4,000	4,800
Total neurologist hours	4,474,800	8,270,900	12,745,700

1. Annual incidence to be seen by neurologists sums to 1.12 percent of the general population.

2. 12,745,700 neurologist-hours per annum reflect 73.8 percent of diagnoses in 2,964 patients in a four-week survey of neurologic practices. Employing such high-quality screening (as that done in the four-week survey), neurologists would need 17,270,600 man-hours per annum, with additional hours necessary for lower-level screening.

3. This would mean the following numbers of neurologists in patient care for a United States Population of 200 million:

Patient-Care Hours/Week*	To Provide 12.7+ Million Neurologist Hrs.	To Provide 17.3– Million Neurologist Hrs.
30	8497	11514
35	7283	9869
40	6373	8635
45	5665	7676
50	5098	6908

For 35 hours per week devoted solely to patient care, there would need to be almost 10,000 neurologists in practice.

* 50 weeks per annum.

Appendix IX

Innovations to Extend the Neurologist's "Reach"

From an economic point of view, neurologists are scarce, high cost resources. Innovations which could lead to a more efficient and intensive use of these resources are, therefore, of great concern to society, the health care field and neurology.

The key concept in such innovations is that of the neurologist's "reach," a concept which includes two components: enhancement of the neurologist's capacity to provide care, directly or indirectly, to more patients; and enhancement of the neurologist's capacity to care for patients at a distance, i.e., obviating the need to bring the patient into direct, personal contact with the neurologist.

Theoretically, such innovations can include a basic reorganization of the health care delivery system, but the concern here is with innovations on a less general level, those which deal more concretely with the interface between patient and physician. Specifically, three types of innovations will be discussed: those involving the use of technological developments; those which make use of alternative personnel; and those which involve some combination of the two.

It should be kept in mind that the innovations reviewed here are only a few of the many now being carried out. Any attempt to identify, much less obtain data on all the numerous experiments now under way was beyond the capacity of the Joint Commission. It should also be noted that the focus is upon institutional programs, those in university medical centers and major hospitals and clinics. Innovations in office-based practice, e.g., computer linked billing and recording systems which can reduce costs as well as free the physician of unnecessary burdens, are not dealt with here. And finally, "blue sky" devices, ones which have been conceptualized but for which the requisite technology is not yet available such as computers which can recognize speech and handwriting, will not be discussed. In short, the programs described below represent only some of the innovations now considered feasible and/or promising.

Technological Innovations

Technological innovations in the delivery of health care involve the use of radio, telephone, television and computers for either the education of physicians and other health professionals or for direct patient care.

One of the early attempts to utilize technology for educational purposes is the Albany Regional Medical Program which has since 1955 held two-way radio conferences to provide continuing education for local physicians. As of 1968, these programs were being broadcast to 72 hospitals at distances up to 120 miles—the range of the FM station.[1]

Extensive use has been made of telephone communication for instructional purposes; many university medical centers have developed dial-access libraries which make available short tapes, usually five to ten minutes in length, on a wide variety of subjects. (Each tape is prepared by an expert in the field.)

The University of Nebraska Medical School used both telephones and videotapes to produce a series of three-way coast-to-coast conferences on mental retardation with participants in Omaha, Los Angeles and Baltimore. Each specialist presented a case at one conference. Then a telephonic tie-in was used when the conferences were rebroadcast to provide a "live" question and answer period with the experts, all of whom made themselves available from home on schedule. This technique, also used for continuing education at all levels, tends to minimize the interruption of work routines.[2]

Among the applications of technology to improve directly the quality and availability of health care is the University of Alabama's medical information service via telephone (MIST) which is available round the clock to all physicians through a WATS number. (This service depends on the presence of a well trained operator to refer calls appropriately.) In its first 18 months the service received 4,300 calls from approximately one-third of the physicians in

Alabama. Most frequently these calls concerned the diagnosis and management of heart disease and stroke.[3]

The Western Electric Company has reported on the transmission of an electrocardiogram from Oklahoma to New York City: the patient in Oklahoma was attached to the electrocardiograph and, by means of a data phone and an appropriate output device, the consultant in New York received a simultaneous paper tracing of the test being done in Oklahoma. The direct transmission was satisfactory.[4] EEG's can also be transmitted by the same technique but one expert who has seen both telephonic and closed-circuit television transmission of EEG's described the latter as more satisfactory.

Telephone lines are used by the Sloan-Kettering Institute to communicate with the 70 hospitals which participate in its Dose Distribution Computation Service. Radiologists in outlying hospitals send in specified measurements for a tumor patient and the computer at Sloan-Kettering calculates the appropriate radiation therapy dosage. Both input and output data are transmitted through teletypewriters linked by telephone lines: phone consults are held as needed. At best, Sloan-Kettering not only provides a needed service which saves computational time but also transmits the most recent state-of-the-art therapy.[3]

One of the first applications of closed-circuit TV to health care was undertaken by the University of Nebraska Medical School in an apparently successful attempt to link the Nebraska Psychiatric Institute with a state hospital which had no staff neurologist and which was located one hundred miles distant from the Institute. Not only were neurological examinations carried out by television but EEG's were transmitted which "could be read quite easily with inexpensive equipment."[2]

At Massachusetts General Hospital, closed-circuit TV is used for teaching residents, for the transmission of EEG's and for patient consults at the Bedford (Mass.) V.A. Hospital. (Dr. Robert Young of Massachusetts General reports that he finds closed-circuit TV to be adequate for all details of the physical examination other than examination of the optic fundi.)

Computer analysis of electrocardiograms has been tested successfully in the opinion of many, although some physicians question the reliability of the analyses. Dr. Robert Elliott, Director of the Community Electrocardiographic Interpretative Service which was funded by the Center for Health Services Research and Development and is located in Denver writes: ". . . there is definitely the potential for a similar application (computer analysis) for EEG . . . However, to my knowledge, the computer analysis of the EEG wave form has many problems yet and . . . its routine clinical application is limited at the present time." Dr. M. G. Saunders of the University of Manitoba, Canada and Dr. Reginald Bickford of the University of California, San Diego are among those concerned with computer analysis of the EEG.

A computer-assisted interview for patients with functional headache is used at Duke University.[5] The interview is a self-administered questionnaire; questions are displayed on a cathoderay oscilloscope and responses entered by means of a keyboard. The areas covered include "clinical symptoms, neurological manifestations, prior treatment, emotional factors and personality problems." On the basis of weights developed by clinical neurologists for each type of migraine and muscle contraction headache, the computer correlates the patient's answers to produce a diagnosis. Computer and neurologist diagnosis agreed in 36 of 50 cases (72%). Although patient acceptance of this procedure was good, some needed assistance with the questions and/or answers because of headache-impaired vision or because of nervousness. (All patients were literate.) The computer interview tended to elicit more comprehensive data on medications, duration of the headache, quality of the pain and its severity, and the location and laterality of the pain than did the physician interview. The experimenters believe that more experience with this technique is needed, but emphasize the potential saving of physician time in this approach.

There are a number of developments in communication technology which have not yet been applied to medical problems. Among them is the Touch-Tone phone as an input-output terminal for remote time-sharing computers to provide convenient, relatively inexpensive and reliable computer service. The output is computer-driven speech over the telephone and the system appears satisfactory for limited input-output. Reliability is enhanced by the storage of essential programs in duplicate, in two remote computers. A permanent record can be obtained by attaching a recorder to the phone terminal for later transcription of messages. The Division of Computer Research and Technology of the National Center for Health Services Research and Development report that the following programs have been developed for this technology: symptom-diagnosis association, hematology differential diagnosis, pediatric burn therapy calculation, intravenous drug compatibility, mass spectrometry drug identification, hospital medication ordering and dispensing, and an electrocardiogram analysis. These programs are divided into two types: those which are essentially computer-hook-ups for dealing with relatively fixed data, as in mass spectrometry reading, and those which deal with data and information sources which are constantly changing, e.g., in the ordering and dispensing of hospital medications. The first group need only additional testing to be operational. The second type of program could serve to relieve professionals of much of the drudgery and time spent in information handling but possible applications are still in the conceptual stage.

Use of Alternative Personnel

Nurse-specialists represent a major innovation in the use of non-physician personnel. There are three neurological nurse-specialists at the Neurological Institute in New York whose principal concern is patient care. These nurse-specialists have extensive experience in neurological problems and are freed of all administrative responsibilities. Thus, they can provide a level of care which other nurses are not in a position to offer, attempting to recognize potential problems and to head them off before they arise. They serve a number of functions, e.g., as patient "advocates" and as educators of patients and their families with respect to the realities of specific neurological conditions and with respect to home planning, helping to prepare the patient and family for the transition from hospital to home. They also try to foster an improved level of patient care through their work with and teaching of staff. Additionally, a group of chronic patients in the neurology outpatient clinic are followed by a neurological clinical specialist rather than a physician; a physician is called in only when the clinical specialist deems it necessary. (These clinical specialists are nurses with a baccalaureate degree plus several years of experience in both bedside nursing and administration, but report it was the desire to return to patient care which motivated their entry into this program.)[6]

Another innovative use of personnel, again of a nurse, is at the Mayo Clinic Neurology Service where a nurse takes patient histories and, for those patients who have not had a general medical examination before coming to the Neurology Service, prepares "a general review of systems, blood pressure, pulse, temperature, weight and pap smears in addition to the neurologic history." The nurse had a B.S. and several years experience in hospital nursing. Among other functons, she has the potential for, in effect, adding to the time available to the neurologist. (One specialist at the Mayo Clinic estimates that she reduces by half the time he must spend in the initial visit.)[7] Because her activities and responsibilities are more precisely defined and circumscribed than those of the clinical specialists at the Neurological Institute, economically she represents a more available resource. And insofar as nurses adequately trained for such responsibilities are less scarce than physicians, this use of nursing personnel can represent a successful innovation in neurologic practice.

Combined Programs

A program at Kings County Hospital, Brooklyn, using a terminal linked to a remote access computer, employs a nurse with some special training to screen all patients referred to the neurology clinic (by the emergency room and other outpatient clinics) for appropriate tests or disposition before the neurologist is called upon to see them.[8] This project, entitled ASSIGN, has two critical functions: to provide immediate attention to patients with neurological problems and to protect the flow system in the neurology clinic from overload by screening out those without neurological problems. The nurse who administers the screening interview to the patient may, at her discretion, use the computer terminal simultaneously with the interview or after she has completed it.

Because of the size of the patient population at the clinic, it is believed that the existence of some screening mechanism is essential for the operation of the neurology clinic itself. (The physician in this particular setting is subject to such pressures from the workload that it is feared that his judgement and his ability to render care may at times be impaired.) Although this is an unusually high-volume facility, it is not atypical in its problems, these tending to be characteristic of many urban outpatient departments, and these facilities service a significant segment of our caseload. However, there have been frequent problems with the terminal. This unreliability of the equipment has made the development of a print-out of specific questionnaire responses for the physician a priority concern, but this itself is a problem because there can be a total of 123 questions asked of any single patient. Finally, when computer evaluation was compared with physician evaluation, the false negative rate by the computer totaled 15 percent and further refinement of the interview is required to reduce this rate.

Another combination of computer and non-physician personnel is employed in the Ambulatory Care Project at Beth Israel Hospital, Boston. Paramedical personnel with a minimum of training but guided by a precisely phrased protocol perform triage on ambulatory patients with new complaints. The actual disposition of patients by this method has been judged satisfactory. With respect to the saving of physician time, 40 percent of the patients were evaluated and prescribed appropriate therapy (as judged by the experimenters) without seeing a physician. In chronic disease cases, where the patient is returning for a follow-up visit, "the protocols address the question of whether the patient need see a physician on the current visit. The chronic disease protocols do not make diagnoses or recommend therapy. In over 1,000 encounters with diabetics and hypertensives, it has been demonstrated that the paramedic can make such a distinction safely."[9] Use of a computer with either the triage or the chronic disease protocols is not judged essential. A similar program for neurological ambulatory care facilities may well be worthwhile.

Conclusion

The various programs which have been reviewed here are, as noted, only a small and not necessarily representative sample of the many such efforts currently being attempted. Which, if any, of those described here will become incorporated into the actual pattern of health care delivery in medicine as well as in neurology, is not yet clear. However, it appears that a number of these innovations will eventually be incorporated into ongoing health care programs, serving to reduce reliance upon specialists without, it is hoped, diminishing the quality of care received by patients. And while the impact of such innovations upon future needs for medical manpower cannot be precisely quantified at this time, it may well be significant.

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Appendix X

Patterns of Neurologic Practice

Neurologic practice represents a combination of consultative work and direct responsibilities for patient care. The exact mix in this combination varies depending upon a number of factors: the physician's own desires, the attitudes of patients, the patterns of practice and attitudes of the referring physicians in the community, the availability in the community of what might be called para-neurological specialists (neurosurgeons, internists, pediatricians, ophthalmologists, radiologists), the particular setting in which the neurologist practices, and the special skills of the individual neurologist.

The importance of these various factors in modifying the type of neurologic practice is in turn dependent upon the size of the community, geographic location, availability of sophisticated neurologic centers, and the system of payment for health care. Of course neurologists, like other physicians, resist placement in particular molds so that even under apparently identical circumstances individual patterns will differ to some extent.

Content of Neurologic Practice

Neurologists are concerned with the diagnosis and treatment of a wide variety of diseases affecting, either directly or indirectly, the brain, the spinal cord, the nerves and the muscles.

In actual practice, the neurologist sees patients with the following problems: one-fourth are people with *painful* conditions especially headache, neck and arm pains, back and leg pains; one-fourth are individuals who lose *consciousness,* have seizures, are demented, confused or have speech difficulties. Others have *weakness* due to stroke or to neuromuscular disorders such as myasthenia gravis, amyotrophic laterial sclerosis and muscular dystrophy. Other patients have disorders of *movement and coordination* as in parkinsonism, multiple sclerosis, or Huntington's disease. People come to the neurologist because of numbness and other sensory disturbances, in neuritis, pernicious anemia, or multiple sclerosis. Children with cerebral palsy, mental retardation, epilepsy and language and learning problems are also in the province of the neurologist. Infections of the brain (abscess, meningitis and encephalitis), brain tumor and trauma are other important conditions.

Neurologists deal with both acute and chronic illness, with benign and debilitating diseases, with conditions for which specific treatment is available and with diseases for which no therapy is known. The pattern of neurologic practice changes with the introduction of new diagnostic methods and treatments. Neurosyphilis and poliomyelitis once constituted a significant portion of neurologic practice but have now almost disappeared; parkinsonism changed from a hopeless condition to one for which there is a specific therapy and has assumed a hitherto unknown degree of importance in neurologic practice. Should a treatment be developed for untreatable diseases like multiple sclerosis, or muscular dystrophy or dementia, the neurologist's role in direct care would unquestionably increase. Confronted with such dread diseases, neurologists tend to be conscious of research and experience has shown that they are prompt to bring their patients the benefits of basic science and clinical investigation.

In terms of the day-to-day clinical practice, the neurologist provides a spectrum of care. They may act purely as a consultant, seeing the patient only once, or he may participate in the day-to-day direct care of the patient by advising or joining the family physician in providing direct care. (There are extremes in terms of specialization in which some neurologists, expert in single diseases, provide consultative services to other neurologists). Which patients become the direct responsibility of the neurologist frequently depends on local patterns of practice but, increasingly, the neurologist is becoming the primary physician for patients with chronic neurologic disease. And whatever his role vis-a-vis the patient, the neurologist assumes a high degree of responsibility for the decision on the types of ancillary diagnostic procedures, e.g., electrodiagnostic and neuroradiologic procedures to be used. Many neurologists actually perform these procedures personally, interpret the results, or do both.

To obtain a detailed picture of the form and content of neurologic practice, observations of six neurologists in different practice settings were carried out by a nonmedical person. Some commonalities in their daily practice emerged.

The neurologist essentially has two bases of operation: the hospital and the office. While making hospital rounds he reviews each patient with the appropriate hospital staff, house officers, nurses, physical therapists, and social workers. The length of time spent with the ancillary personnel, the patient and the family depends upon both the medical problem and the patient's or family's need for emotional support. In addition to his own patients, the neurologist is often stopped in the corridor by other physicians. Other neurologists may request information regarding their patients or may offer information in response to an academic question; others, neurologists or non-neurologists, may request a formal consultation in which the neurologist sees a patient to aid in diagnosis and management. The neurologist may also be questioned by ancillary personnel regarding individual patients or more general problems about particular neurologic diseases. In the office, it is also likely, depending upon the setting, that the neurologist will be called upon for corridor consultations. Time spent with office patients is often interrupted by telephone calls from other patients or by family members asking about conditions, reporting new symptoms, or requesting refills of prescriptions. Physicians also make telephone calls, referring patients or requesting telephone consultations.

There were differences among the six neurologists, particularly in the use of diagnostic procedures. (It has been suggested that younger, less experienced physicians will rely more heavily on tests to determine or confirm the diagnosis than the more experienced neurologist who relies more heavily on the patient's history and the neurologic examination.)

In the past, little if any emphasis was placed upon the teaching of neurology in many medical schools. Now, however, nearly all medical schools require courses in clinical neurology. Still the neurologist performs an important educational function for non-neurologists (family practitioners, internists, pediatricians, psychiatrists, neurosurgeons, house officers, medical students and allied health personnel) by helping them recognize the signs and symptoms of neurologic illness and assisting them in the primary care of patients with disease of the nervous system.

Because of the nature of the diseases of the nervous system and their protean manifestations, there is not a single medical or surgical specialty which does not at one time or another require the services of the neurologist. To put it another way, almost every single systemic disease known may at one time or another involve the nervous system and produce signs and symptoms indicative of its malfunctioning.

The Setting of Neurologic Practice

There are basically three settings in which neurologists practice: solo practice, group practice, or a University medical center.

1. (Solo Practice): The solo practitioner carries out both consultations and primary care in the hospital and in the office.

Two important factors which modify the size and content of this kind of practice are the availability of a neurologic center and the composition and degree of sophisitication of the medical community. There is reason to believe that the better informed, neurologically more sophisiticated physician, is more apt to refer patients to the neurologist. While physicians such as neurosurgeons, psychiatrists, orthopedic surgeons, physiatrists, certain internists and pediatricians, will conceivable provide some form of neurologic care to patients who would otherwise be referred to the neurologist, it has been repeatedly shown that the availability of a neurologist in the community leads to reliance upon the particular skills of the neurologist. Indeed, the advent of a neurologist in practice in many communities has uncovered large numbers of patients who previously received no neurologic care whatsoever, or less than optimal care from non-neurologists.

2. (Group Practice): There are two types of group practices to be considered. One is a group consisting exclusively of neurologists, or more commonly, an association of neurologists and neurosurgeons. The role of such uni-specialty groups is very similar to that of the solo practitioner; the differences are in the economic advantages of pooling administrative and equipment costs and the capacity of the uni-specialty group to provide a wider range of sub-specialty services. (In many ways, uni-specialty groups resemble the practice components of the university-medical center departments of neurology.) These uni-specialty groups basically tend to serve the community practitioners at large.

The multi-specialty group, exemplified by the Mayo Clinic and University-based groups, provides the neurologist with an immediate availability of supporting and ancillary services which is not feasible with the solo practitioner. On the other hand, the neurologist in multi-specialty groups may be restricted to internal referrals, depending upon the pattern of medical practice in the community.

In both uni- and multi-specialty groups, the mixture of primary care and consultative practice varies considerably. The neurologist's own skill and interests, his sophistication and ability in areas such as electroencephalography, electromyography, neuroradiologic procedures, and his willingness to provide direct care for patients with psychiatric and other conditions related to the primary neurologic problem affect the mix of direct care and consultative work.

In many communities, the presence of a neurologist, regardless of practice setting, leads to a remarkable shift in the referral pattern of patients with neurologic disease. Many who were formerly referred to neurosurgeons are now referred to neurologists. This comes from the recognition by referring physicians that neurologists have special training and develop particular skills not possessed by other specialists, and often the practicing neurologist serves an important educational role in the medical community.

In all settings, the system and method of payment for neurologic services can influence the quality and quantity of neurologic care. Certainly, the quality of neurologic care is enhanced by systems that encourage freedom of consultation.

3. (Medical Centers): The spectrum of care within teaching institutions is similar to that of neurologic practice anywhere. However, neurologic practice here is modified by the degree to which the university hospital also serves as a community hospital. The greater the orientation toward the community, the more likely is direct care rather than consultation to be delivered.

As a general rule, medical centers are much more likely to admit patients to the neurologic services with difficult diagnostic and treatment problems. The neurologist will also provide consultation for difficult neurologic problems on other services. The management of the more common neurologic problems will, in part, depend upon the extent to which the university hospital is utilized as a community hospital.

Because of the availability of individual neurologic specialities, extensive supporting specialties and ancillary services, sophisticated diagnostic techniques and equipment, the neurologic practice in medical centers represents medically the most sophisticated form of neurologic care.

Quite often, the university medical center, especially in large metropolitan areas, may be the *only* medical care facility available to large segments of the poor. The role of the neurologist in the medical center, may, therefore, be modified to some extent by the center's geographic location, be it in a large metropolitan area, in a small town, or in a semi-rural area. The mixture of primary care as opposed to consultative work is very much modified by such geographic locations.

Principles for Optimal Neurological Care

There is little consensus about the optimal patterns of organization of medical and neurologic practice. Nonetheless, there appears to be a limited number of general principles as well as specific goals which should be seriously considered and, if possible, implemented. These include:

1. The pooling, whenever possible or advisable, of resources on a rational basis in special diagnostic and therapeutic areas. Highly specialized and sophisticated services should not be duplicated unless there is clear evidence of need and a demonstration of expected utilization.
2. The more common neurologic disorders should be properly handled in the community by neurologists based in these communities.
3. Community hospitals should not duplicate either the complex and sophisticated equipment or the personnel resources more appropriate in a specialized neurological center, but should provide the common diagnostic and treatment facilities, these operating under the supervision of the community based neurologist.
4. The establishment of model neurologic centers for the purpose of providing and exemplifying the ultimate in diagnostic and therapeutic capabilities, these centers to be manned by the most skilled personnel and to have at their disposal the most sophisticated techniques and equipment available. (The exact criteria for determining the number and location of these centers, e.g., accessibility, population, availability of resources, etc., need to be determined.)
5. The neurologic center should provide continuous support to the community based neurologist by several means.
   a. Organization of an efficient and economic referral and transportation system.
   b. Educational programs for non-neurologists in the medical community.
   c. Telephone and television consultation.
   d. Provision of traveling consultants, both in

general neurology and in the neurologic subspecialties, to serve the community hospitals on a regular basis.

e. Utilization of community hospitals for residency training programs under the joint supervision of the neurologic center and the community neurologist.

f. Training of specialized "neurologic assistants" to increase the efficiency of the practicing neurologist by performing certain routine and non-critical tasks.

g. Participation of the community based neurologist in direct care activities of the neurologic center to provide continuity of care for the patient.

6. Large metropolitan outpatient clinics, as presently organized, do not always provide optimal neurologic care, and ambulatory services should be reorganized to approach the pattern of office practice.

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Appendix XI

The Neurologist as Researcher

This report will examine those 367 neurologists (11 percent of all neurologists) who, according to the A.M.A. file, describe their primary professional activity to be research, presumably neuroscience research. This group, it should be noted, comprises only part of all those—neurologists, other physicians and physical and behavioral scientists—engaged in neuroscience research.

Thus, the Joint Commission, as part of its study on neurologic education, sent a questionnaire on current manpower resources to neurology programs at 102 medical schools, 99 of which responded. Analysis of the results indicated that 751 neurology department staff members are engaged in research activities "as their sole activity or as a related part of their total academic program." The number is twice the number in the A.M.A. file who specified research as their principal activity. Further, among the neurologists responding to the American Academy of Neurology survey of its members on their allocation of time to different professional activities, 57 percent report devoting some part of their professional time to clinical research, 25 percent some time to basic research. Even though there may be a great deal of overlap in these figures, some neurologists responding that they do both basic and clinical research, they certainly indicate that the 367 neurologists listing research as their primary professional activity in the A.M.A. file do not account for all research in neurology. In addition, the International Brain Research Organization (IBRO) sent a questionnaire "to persons directly or indirectly responsible for research programs" in institutions granting the Ph.D., M.D., D.V.M., D.D.S. and D.O. degrees and to others, as well. Results of the survey were published in 1968 in *IBRO Survey of Research Facilities and Manpower in Brain Sciences in the United States.* While not all of the projects listed are directly related to neurological disease, 373 organizations, 880 research groups and 4,245 researchers are identified as doing work in neuroscience research.

Despite the fact that this group of 367 neurologists represents only one segment of all those involved in neuroscience research, they are a particularly important segment and thus worth an examination in detail. First, while basic neuroscience research is not and quite possibly should not be the sole or primary responsibility of neurologists, clinical research must be. Research neurologists, therefore, occupy a necessary and critical role in the "pay-off" area of neuroscience research. Second, if the self-report of these 367 neurologists is accurate, they, because of their *degree* of involvement in neuroscience research, represent a disproportionate amount of the total neurology effort in neuroscience research.

Educational Background

Of the 367 neurology researchers, a substantial portion are graduates of foreign and Canadian medical schools: In 1971 foreign graduates comprised 24 percent of neurology researchers and 21 percent of all neurologists; Canadian graduates 4 percent of neurology researchers, 3 percent of all neurologists.

The data on graduates of American medical schools choosing research in neurology as a career indicate that the school attended is a significant variable. Table 1 shows that 13 schools graduated 48.9 percent of all American graduates choosing research in neurology, indeed that only six of these schools graduated 35.6 percent of the total. At the same time, these 13 schools graduated only 35.0 percent of all American graduates choosing neurology as their specialty.

The report, "Neurology Manpower in the United States, 1971," suggested that medical school "atmosphere" can be an important factor in a graduate's choice of neurology as a specialty. The results in Table I, which indicate that there are certain schools whose graduates tend to focus upon neurology research disproportionate to the number of graduates choosing neurology, suggest that there may not only be a school "atmosphere" affecting specialty choice but also one affecting choice of research as the focus of professional concern.

Along these lines, the A.M.A. publication, *Medical School Alumni, 1967,* was used to determine the percent of graduates from different schools in all fields of research and the percent of neurology graduates in research. Data on the six medical schools (all private) which led all others in the proportion of graduates choosing research careers are presented in Table 2.

TABLE 1

Schools Graduating One-Third of All Neurologists and One-Third of Research Neurologists, 1915–1971

Medical School	Percent of American Neurology Graduates	Percent of American Graduates in Research
Harvard	4.1	11.1
Columbia	3.2	6.5
N.Y.U.	2.8	5.0
Case Western Researve	1.7	5.0
Pennsylvania	4.1	4.2
U. Chicago	2.4	3.8
Total, 6 Schools	18.3	35.6
Cornell	2.6	2.7
Northwestern	2.5	2.3
Jefferson	2.5	1.5
Illinois	2.4	1.5
Michigan	2.4	2.7
Minnesota	2.2	1.5
Indiana	2.0	1.1
Total, 13 Schools	35.0	48.9
All American Graduates	2566 = 100.0	267 = 100.0

Source: A.M.A. File.

A number of points should be noted. First, except for the University of Chicago where the percent of neurology graduates engaged in research was exactly the same (4.3) as the percentage of all graduates engaged in research in 1967, the percentage of neurology graduates from the other five schools engaged in research was much higher than the percentage of all graduates in research. This may reflect the emphasis on research in neurology compared to other specialties.

A second point worth noting is the fact that only three of the six schools with the highest percentage of neurology graduates choosing research are among the 13 schools (Table 1) which graduate the most neurologists. One reason for this lack of congruence may be the relatively small number of total graduates from a particular school either because of its size or, in the case of Einstein, because of its newness. A second possibility is that certain schools somehow graduate disproportionate numbers of neurologists, others a disproportionate number of researchers, and others, both. Research on the relation of medical school characteristics to both specialty and activity choices by graduates might well yield important insights into the factors affecting careers in medicine.

A third point about the data in Table 2 which should be noted are the changes, mainly increases, between 1967 and 1971 in the percentages of these schools graduating neurologists in research. This is, in part, a statistical artifact resulting from the A.M.A. reclassification of physicians' activities in 1968.

TABLE 2

Graduates of Six Schools in All Research, and in Neurological Research

Medical School	Total Number of Active Graduates 1967	Percent of All Graduates in Research 1967	Percent of Neurology Graduates in Research 1967	Percent of Neurology Graduates in Research 1971
Harvard	6,154	5.0	11.5	27.9
U. Chicago	1,987	4.3	4.3	16.1
Yale	2,446	3.8	11.5	11.9
Johns Hopkins	3,581	3.8	12.5	13.9
Columbia	4,943	3.6	13.4	20.7
Einstein	742	3.1	17.6	12.5
All Graduates*	294,072	1.6	5.2	10.8

*Includes Canadian and foreign medical graduates.
Sources: *Medical School Alumni, 1967;* A.M.A. tape.

Thus, data for the years before 1968 are not strictly comparable with data from 1968 on.

Demographic Characteristics and Present Location

The major demographic difference between neurology researchers and other neurologists is age. (There is a minor sex difference, women comprising 6 percent of neurology researchers, 7 percent of all neurologists.) Table 3 indicates that almost 70 percent of the neurologists in research are under 45 years of age compared to 61 percent of all trained neurologists. And only 8.5 percent of research neurologists are 55 years of age and older compared with 17.6 percent of all other trained neurologists. This may reflect the fact that the great expansion of both research and research opportunities in neurology is a relatively recent phenomenon.

Where is neurology research carried out by these 367 neurologists? Table 4 shows the location of researchers and of all other trained neurologists by SMSA's. (An SMSA, or standard metropolitan statistical area, is defined as a central city which, with its surrounding counties, has a combined population greater than 50,000.)

The data indicate that research neurologists are even more heavily concentrated in the largest areas than are all other trained neurologists.

The fact that four out of five neurology researchers are located in the largest cities is in good part explained by the practice settings in which they work (Table 5). At least 57 percent of research neurologists work in medical schools (and almost all medical schools are in SMSA's).

Another 17 percent of the research neurologists work in non-federal hospitals, while the balance work in "other" practice settings. The finding that 17 percent of neurology researchers work in "non-federal hospitals" was somewhat unexpected, but, from the addresses of the 62 researchers located in non-federal hospitals, it was possible to establish that at least 32 of them are located in university hospitals or hospitals affiliated with medical schools. This increases the proportion of researchers who are essentially based in medical schools to 66 percent and reduces to 8 percent those in other non-federal hospitals. (Since some addresses are not hospital addresses, it is possible that even more are in affiliated hospitals.) This distribution of research neurologists is quite different from that of all other trained neurologists, almost half of whom (49 percent) are in solo or group practice.

TABLE 3

Research Neurologists and All Other Trained Neurologists by Age, 1971

Age	All Other Trained* Neurologists (percent)	Research Neurologists (percent)
25–34	17.8	15.8
35–44	43.1	53.7
45–54	21.5	22.1
55–64	9.0	5.2
65 +	8.6	3.3
N	2239	367

*Excludes 792 neurology residents and the 367 neurologists in research.
Source: A.M.A. tape.

TABLE 4

Distribution of Research Neurologists and All Other Trained Neurologists in SMSA's

Population of Aggregated SMSA's	All Other Trained Neurologists* (percent)	Research Neurologists (percent)
+ 1 million	61.7	80.3
500,000–1 million	13.8	6.4
less than 500,000	24.6	13.3
N**	2195	361

*Excludes 792 neurology residents and the 367 research neurologists.
**Excludes 46 neurologists for whom no address is known, six of whom are primarily in research.
Sources: A.M.A. tape; 1970 census figures.

TABLE 5

Research Neurologists and All Other Trained Neurologists in Various Practice Settings

Practice Setting	All Other Trained Neurologists* (percent)	Research Neurologists (percent)
Private Practice**	48.8	3.9
Medical School	15.9	57.2
Non-Federal Hospital	12.7	16.9
Veterans Administration	6.2	5.4
Other Federal Facilities	7.7	3.3
Other Settings	8.7	13.3
N	2239	367

*Excludes 792 neurology residents and the 367 neurologists in research.
**Includes solo and group practitioners.
Source: A.M.A. tape.

In order to determine whether neurology researchers and funds for neurology research tend to flock together, the percentage of neurology researchers and NINDS research awards for each of the 9 census divisions were calculated (Table 6). The data indicate that a "flocking" effect does take place: indeed a rank order correlation between the percentage of research neurologists and number of awards gave a value of +.88, significant at p = .01.

Trends in the Recruitment of Neurology Researchers

Eleven percent (367) of the 3,398 neurologists on the A.M.A. file report themselves as primarily engaged in research. In order to obtain some idea of trends in the recruitment of neurologists into research, data on the proportion of neurologists in research in earlier years was sought. An examination of the A.M.A. annual publication, *Distribution of Physicians in the United States*, shows that despite a 24-percent increase in the total number of active neurologists from 1968 to 1971, not only the *proportion* but also the absolute number of those reporting research as their principal activity declined in that period (Table 7). Thus, the A.M.A. *Distribution* showed a decline from 466 research neurologists in 1968 to 382 in 1971, a decline of 18 percent in the actual *number* of neurologists primarily engaged in research. (In 1968, 17.4 percent of all neurologists were primarily engaged in research; in 1971, 11.5 percent.) This shift in both the number and percentage of neurologists primarily engaged in research is striking; if the 1968 percentage of all neurologists primarily engaged in research (17.4) had remained constant through 1971, there would have been 577 research neurologists in 1971, about 50 percent more than the 382 reporting themselves to be so occupied. (The minor discrepancies in both total number of neurologists and total number of research neurologists on the Joint Commission copy of the A.M.A. file and those reported by the *Distribution* can be explained by the fact that the date on which the file was copied for use by the Commission was different from (later than) the date on which that file was analyzed for the 1971 *Distribution*.)

If only changes in the proportion of all neurologists engaged in research had taken place, it could be argued that the educational and research infrastructure requisite for the expansion of neurology having been developed, proportionately more of recently trained neurologists were devoting themselves to patient care than had been the case previously. Given both the need for patient care neurologists and the proportionately greater number of neurologists in research compared to other specialties,the argument has a certain face validity. However, the decline is also in the absolute number of neurologists primarily engaged in research and, whatever the explanation, this would appear to be a poor augury for neurological research and for the clinical developments deriving from such research.

Why was there such a large drop, absolutely and relatively, in research neurologists over this four-year period? Perhaps, as has been argued, the largest single factor was the decline in funds for training and research. The data presented in Table 8 show that

TABLE 6

Distribution of Research Neurologists and NINDS Research Funds by Census Division, FY 1971

Census Division	Research Neurologists (percent)	NINDS Research Awards Number (percent)
New England	13.0	12.2
Middle Atlantic	27.4	22.2
E. N. Central	8.0	14.5
W. N. Central	8.3	8.8
South Atlantic	19.7	11.5
E. S. Central	0.8	2.9
W. S. Central	3.1	5.0
Mountain	2.5	3.7
Pacific	16.6	18.4
All U.S. (number)	361*	1,259

*Excludes six neurologists for whom no address is known.
Sources: NINDS; A.M.A. file.

TABLE 7

Change in Number of Neurologists and Research Neurologists

Year	All Active Neurologists	Neurologists in Research	Research Neurologists as Percent of All Neurologists
1968	2,671	466	17.4
1969	2,850	403	14.1
1970	3,074	411	13.4
1971	3,317	382	11.5
Percent Change, 1968–71	+24.0	−18.0	

Source: A.M.A., Distribution of Physicians . . . in the U.S., appropriate years.

NINDS awards for research training programs in neurology declined 29 percent between fiscal 1968 and fiscal 1972, from almost five million dollars to three and a half million dollars, and that the value of the average award decreased 7 percent, from $61,880 to $57,750. (Allowing for inflation during this period, the real decrease is substantially greater than 29 percent and 7 percent.) And, as a result of this decline, the number of funded programs decreased from 80 to 61, 24 percent.

With respect to funds for research as represented by grant awards, the peak year in NINDS funding was fiscal 1969, when 1,878 grants received 67.8 million dollars. By fiscal 1972 the total number of research grants had dropped to 1,339, a decline of almost 29 percent. Table 9 shows the changes from fiscal 1964, the year NIH funded the largest number of grants. During the interval 1964–72, the dollar amounts of grants awarded by all eight institutes increased 50 percent while the dollar amounts of grants awarded by NINDS increased by only 32 percent. (and the proportion of funds going to neurological research via NINDS dropped from a peak of 14 percent of the NIH total in fiscal 1969 to 10 percent in fiscal 1972.)

Even though it can be argued that correlation is not causation, it would appear that the decline in the number of research neurologists is associated with the decline, absolute and proportional, of NIH funds going to neurological research and research training through NINDS.

TABLE 8

Neurology Training Programs Funded by NINDS

Fiscal Year	Total Awarded	Average Award per Program	Number of Funded Programs
1968	$4,950,000	$61,880	80
1972	$3,524,000	$57,750	61
Percent Change, 1968–1972	−29	−7	−24

Source: NINDS.

TABLE 9

Research Grants Awarded by NINDS and by NIH, Selected Fiscal Years

Year	NIH*		NINDS	
	Number	Amount (Thousands)	Number	Amount (Thousands)
1964	14,785	$424,074	1,639	$48,512
1969	11,438	$489,476	1,878	$67,761
1972	10,084	$636,960	1,339	$63,844
Percent Change:				
1964–69	−22.6	+15.4	+14.6	+40.0
1969–72	−11.8	+30.1	−28.7	−5.8
1964–72	−31.8	+50.2	−22.4	+31.6

*The total numbers and amounts under NIH include *only those institutes* constantly under NIH, 1964–1972: NCI, NHLI, NIAID, NIAMDD, NICHD, NIDR, NIGMS, NINDS.

Source: NIH Almanac, 1973, pp. 120, 121.

Appendix XII

Funded Neuroscience Projects, 1971

As part of the attempt to obtain a picture of current neuroscience research, data on funded research projects for 1971 were obtained from two sources: a Science Information Exchange (SIE) computer printout, *Grants, Contracts and In-House Research in Basic and Clinical Neurosciences*, listing 4,152 projects for fiscal 1971 and a National Institute of Neurological Diseases and Stroke computer printout listing 1,289 projects funded during 1971.

The SIE listing included four pieces of data: project title, name and location of grantee institution and source of funding. The NINDS listing included, in addition to project title and name and location of grantee institution, the name of the principal investigator, the total length of the grant period and the amount of the grant.

The two lists overlap a great deal, more than 50 percent of the NINDS grants clearly present on the SIE listing. (The degree of overlap may well be greater but it was not always possible to determine if specific listings referred to the same project.) Thus, at least 15 percent of the grants on the SIE listing are represented by NINDS grants, a point which should be kept in mind throughout the discussion. It should also be noted that almost all of the listings, on the basis of their titles, appear to be of research projects. (Training grants were few in number, less than 3 percent of all NINDS grants and an even smaller percentage of the SIE grants.)

Sources of Neuroscience Funding

A total of 173 funding agencies were represented on the SIE listing. The major funding sources as well as the total number of neuroscience projects sponsored by each are given in Table 1. Nine of the 173 funding agencies sponsored 95 percent of all projects. At least 88 percent of all the projects listed are funded by governmental agencies, 84 percent by the federal government and 4 percent by the Canadian government (most of these located in Canada). The United States Department of Health, Education and Welfare is the major source of neuroscience grants, 58 percent through the Public Health Service and 5 percent through the Social and Rehabilitation Service, a total of 63 percent of all grants listed.

It is worth noting that even if all of the 1,289 NINDS grants are assumed to be included in the PHS total of 2,398, it would appear that as many as 1,109 neuroscience projects, 31 percent of the total, are funded by other divisions of the Public Health Service. This may reflect the intertwining of neurological with other systemic problems.

Distribution of Neuroscience Grant Recipients

The distribution of neuroscience grant recipients can be viewed in terms of three dimensions: by geography, grantee institution and principal investigator.

TABLE 1

Sources of Neuroscience Grant Funding, SIE Listing, 1971

Funding Agency	Number	Percent
Public Heath Service (H.E.W.) including N.I.N.D.S.	2,398	57.8
Veterans Administration	630	15.2
Social and Rehabilitation Service (H.E.W.)	193	4.6
Department of Defense	191	4.6
Navy (71)		
Army (67)		
Air Force (53)		
Canadian Government	184	4.4
Heart Associations *	105	2.5
National Science Foundation	103	2.5
National Multiple Sclerosis Society	74	1.8
Atomic Energy Commission	43	1.0
All Other Sources	231	5.6
Total	4,152	100.0

* Includes 44 separate heart associations throughout the United States.

With respect to geography, Table 2 shows the distribution of grants in the United States, Puerto Rico, Canada and other foreign countries. (Data are presented separately for the SIE and NINDS listings, a pattern which is repeated wherever possible.) Nearly all of the neuroscience projects listed are being conducted in the United States. Of the 1,289 NINDS supported projects, 1,259 are located in one of the 50 states, two are in Puerto Rico and only 28 projects are located in foreign countries, two in Canada and 26 (2 percent of the total) in other foreign countries. Of the 4,152 projects in the SIE listing, 92 percent are in the United States, none in Puerto Rico. Six percent of the total, 229 grants, are in Canada, the great majority of these supported by the Canadian government. Only 88 projects, 2 percent of the total, are in foreign countries other than Canada. The major difference between the two listings is in the higher proportion of SIE grants located in Canada, a difference which can be explained by the support given to projects in Canada by the Canadian government.

The distribution of neuroscience grant recipients in the United States by census region and division is presented in Table 3. At first glance, there appears to be a striking difference between the two listings with respect to the percentage of grants located in the South Atlantic census division, 23 percent of all projects on the SIE, 12 percent of those funded by the NINDS. However, the NINDS listing includes only extramural grants while the SIE listing also includes intramural grants, that is, grants from one arm of the federal government to another, specifically 305 grants to the United States Department of Health, Education and Welfare, Public Health Service, Bethesda and 78 grants to H.E.W., Washington, D.C. These 383 intramural grants, all in the South Atlantic census division, comprise a little over 9 percent of all the 1971 neuroscience projects within the United States listed by the SIE. If these 383 grants are excluded from the analysis, then the percentage of SIE grants in the South Atlantic division is reduced to 15 percent and the distribution of grants on the two listings becomes almost the same.

TABLE 2

Neuroscience Grant Recipients by Country

	SIE		NINDS	
	Number	Percent	Number	Percent
United States	3,835	92.4	1,259	97.7
Puerto Rico	—	—	2	*
Canadian	229	5.5	2	*
Foreign	88	2.1	26	2.0
Total	4,152	100.0	1,289	100.0

* Less than 1 percent.

The NINDS grantee institutions were classified as medical schools, medical school-affiliated hospitals, medical school-affiliated research institutes, universities with a medical school component but where the specific school or department of the principal investigator could not be determined, universities without a medical school, unaffiliated hospitals, independent research institutes, other institutions and recipients which could not be categorized. (This process required a check of the names of principal investigators, in medical school catalogues and the Directory of Medical Specialists, to determine whether or not the grant was to a medical school specifically; the

TABLE 3

Neuroscience Grant Recipients by Census Region and Division

	SIE**		NINDS	
	Number	Percent	Number	Percent
Northeast				
New England	369	10	154	12
Middle Atlantic	703	18	280	22
Sub-total	1,072	28	434	35*
North Central				
East North Central	481	13	185	15
West North Central	245	6	112	9
Sub-total	726	19	297	24
South				
South Atlantic	899	23	147	12
East South Central	106	3	37	3
West South Central	202	5	65	5
Sub-total	1,207	31	249	20
West				
Mountain	166	4	47	4
Pacific	664	17	232	18
Sub-total	830	22*	279	22
Total	3,835	100	1,259	100

* Rounded.

** Includes intramural grants, as NINDS does not.

SIE listing, which did not provide the names of the principal investigators, could not be used in this phase of the analysis.)

The distribution of grants by type of institution is given in Table 4. Medical schools are the primary institutional recipients of NINDS grants, 55 percent of the total. And if medical school-affiliated hospitals and research institutes are combined with medical schools, the figure becomes 63 percent of all grants. The only other significant institutional recipients of NINDS grants are universities, 32 percent. Even here, medical school ties make a difference: universities with medical schools have 22 percent of grants, universities without, only 10 percent. Whether this difference comes about because universities with medical schools tend to have larger biological science programs or because of some other factor cannot be determined.

Table 5 presents the ten leading institutional recipients of NINDS grants in 1971. These ten institutions, less than 4 percent of all institutions receiving NINDS support that year, account for 23 percent of all grants. Table 6 presents the ten leading institutional recipients on the SIE listing of neuroscience grants in 1971. These ten institutions, 1.6 percent of all the institutions identified as receiving support for neuroscience projects in that year, account for 17.6 percent of all grants.

Seven universities—U.C.L.A., Washington University, Johns Hopkins, Pennsylvania, Yale and Yeshiva—are among the leading grant recipients on both lists while New York University and the University of Colorado (Denver) are in the top 15 on the NINDS listing as well as in the top ten of the SIE listing. Only four universities—Columbia, the University of Washington, the University of Michigan and Emory University—are prominent on one list but not on the other. It would appear, given this concentration of grants in a limited number as well as type of institutions, that funding agencies tend to concentrate funds in a limited number of institutions,

TABLE 4

NINDS Grants for 1971 by Type of Grantee Institution

Institution (U.S.)	Number of Grants	Percent of Total
Medical School	691	54.8
Medical School-Affiliated Hospital	81	6.4
Medical School-Affiliated Research Institute	30	2.4
University (with medical school)	282	22.4
University (no medical school)	124	9.8
Unaffiliated Hospital	23	1.8
Independent Research Institute	3	*
Other	10	0.8
Unclassified	15	1.2
Total	1,259	100.0

* Less than 1 percent.

TABLE 5

Leading Institutional Recipients of Neuroscience Grants from NINDS, 1971

Institution and Rank	Number	Percent
1.0 U.C.L.A.	54	4.2
2.5 Washington University	33	2.6
2.5 Johns Hopkins University	33	2.6
4.0 University of Pennsylvania	29	2.2
5.5 University of Washington	26	2.0
5.5 Yale University	26	2.0
7.0 University of Michigan	25	1.9
8.5 Harvard University	24	1.9
8.5 Yeshiva University	24	1.9
10.0 Columbia University	22	1.7
Total	296	23.0
Base	(1,289)	(100.0)

TABLE 6

Leading Institutional Recipients of Neuroscience Grants, SIE Listing, 1971

Institution and Rank	Number	Percent	Rank Order, NINDS Listing
1. Washington University	90	2.4	2.5
2. U.C.L.A.	86	2.3	1
3. New York University	84	2.2	*
4. Harvard University	81	2.1	8
5. University of Pennsylvania	62	1.6	4
6. Johns Hopkins University	58	1.5	2.5
7. Yeshiva University	53	1.4	8.5
8. Yale University	51	1.4	6
9.5 University of Colorado (Denver)	49	1.3	**
9.5 Emory University	49	1.3	***
Total	663	17.6	
Base	(3,769)****	(100.0)	

* Tied with two others for 12th place, NINDS listing.

** Tied for 13th place, NINDS listing.

*** Not in top 20 of NINDS listing.

**** Excluded from this listing and from the base used for computations are a total of 383 grants, 305 grants to United States Department of Health, Education and Welfare, Public Health Service, Bethesda and 78 to H.E.W., Washington, D.C.

frequently medical schools, presumably those defined by them as centers of excellence in neuroscience research.

In order to obtain background data on principal investigators of neuroscience projects, a search was made in medical school catalogues and the Directory of Medical Specialists for the names of those listed by the NINDS as principal investigators of the research projects located in the United States.

The professional degree for 691 principal investigators representing 55 percent of the 1,259 projects was determined by this procedure: 328 (47 percent) of the 691 are M.D.'s, 296 (43 percent) are Ph.D.'s, 52 (8 percent) have both an M.D. and Ph.D. and 15 (2 percent) have other degrees. Given the concentration of neuroscience projects in medical schools, it is surprising that only 55 percent of those principal investigators who were identified are M.D.'s.

Areas of Funding

The analysis of the data from SIE and NINDS included an attempt to categorize the various projects through an examination of titles into basic research, clinical research, training, etc. However, it soon became apparent that a reliable classification of this nature could not be made and instead the titles were examined to determine whether or not the project dealt with specific clinical entities.

Of the 4,152 projects on the SIE listing, 304, 7 percent of the total, referred to a clinical entity in the title; of the 1,289 projects funded by the NINDS, 87, also 7 percent, referred to some clinical problem in the title. Thus, insofar as such measurements are valid indicators, the NINDS does not differ from other sources of neuroscience funding in the proportion of its grants specifically focused upon particular disorders. It is worth noting that 76 percent of the principal investigators of these "clinical" projects are M.D.'s compared to 55 percent for all projects.

The next step was to examine the nature of the "clinical" titles. Table 7 compares the two listings with respect to the clinical problems referred to in the title. Only 14 percent of the SIE titles deal with the stroke problem (stroke, hypertension, cardiovascular) while 43 percent of the NINDS grants do. The only projects dealing with muscular dystrophy and ischemia are NINDS supported. Also, as suggested by the differences in the "All Other" category, the NINDS funds a wider variety of studies dealing with specific neurologic diseases (myasthenia gravis, Huntington's chorea, otitis media, Krabbe's disease,

TABLE 7

Grants by Specific Disease or Symptom, if Mentioned

Disease or Symptom	SIE		NINDS	
	Number	Percent	Number	Percent
Multiple Sclerosis	50	16	3	3
Stroke, Hypertension	43	14	17	20
Cardiovascular	—	—	20	23
Spinal Cord Injury, Plegias	43	14	5	6
Epilepsy	28	9	8	9
Parkinsonism	28	9	3	3
Aphasia, Deafness, Communication Disorders	22	7	10	11
Mental Retardation	18	6	4	5
Illegal Drugs (use/abuse/effects)	17	6	—	—
Cerebral Palsy	14	5	—	—
Schizophrenia	13	4	—	—
Amyotrophic Lateral Sclerosis	11	4	1	1
Brain Tumor	7	2	—	—
Ulcer	7	2	—	—
Muscular Dystrophy	—	—	4	5
Ischemia	—	—	3	3
All Others	3	1	9	10
Total	(304)	99*	(87)	99*

* Rounded.

Tay-Sachs disease, etc.) than do all SIE agencies. The SIE listing, on the other hand, is more likely to have projects dealing with multiple sclerosis (16 percent vs. 3 percent, undoubtedly because of the National Multiple Sclerosis Society), spinal cord injury and plegias (14 percent vs. 6 percent), parkinsonism (9 percent vs. 3 percent), illegal drugs, cerebral palsy and schizophrenia (6 percent, 5 percent and 4 percent respectively on the SIE listing, none on the NINDS listing). In short, if the NINDS and all SIE funding agencies choose similar recipients for their neuroscience research grants, still they appear to direct their funds toward dissimilar clinical problems.

Appendix XIII

Present Status and Future of Basic Research in Neuroscience

The past three decades have seen a phenomenal growth in basic science research on the nervous system, largely due to the support which has been provided by the National Institutes of Health and other governmental agencies. (The effectiveness of supporting research in that fashion had been demonstrated during the Second World War by the accomplishments of the Office of Scientific Research and Development and of the Office of Naval Research.) Yet, in spite of this growth, we are only at the beginning of what may be expected, so vast is the unknown which must still be explored.

I shall attempt to highlight a few of the trends in current research which seem important to me and point to some of the areas which need to be explored, always with the thought in mind that the fullest understanding of the basic structure and function of the nervous system is essential for any effective, practical application of knowledge in the alleviation of the ills of mankind in this field.

Single unit analysis of sensory and motor systems

This is one of the most active areas of neural research at the present time. It is being used throughout the world on almost all parts of the nervous system, but particularly effectively in the fields of *somesthesis, vision, audition* and *motor function*, in both anesthetized and unanesthetized animals. It is also finding useful application in the operating room for studies on man as a practical guide to *surgical therapy*.

The *somesthetic system* has received much attention from Mountcastle and his associates, with special reference to correlating neurophysiological and psychophysical data, through comparison of results obtained on unanesthetized monkeys with human psychophysical facts. The analyses have been limited largely to cutaneous pressure receptors with little attention being given as yet to muscle afferents. The somatic sensory system is being studied at all levels from receptors to cerebral cortex and special interest, as in the studies of Welker and his colleagues, has centered on the evolution of the system and the relations of its properties to the behavioral characteristics of different creatures.

Current attention is also being given to *thermoreceptor mechanisms* (Poulus; Darian-Smith) both in peripheral nerve and at various levels of the CNS. However, only a beginning has been made and much remains to be done.

Unit studies on the neural mechanisms of *pain* have been made at spinal levels, especially by Perl, but to date little has yet been done at the higher levels of thalamus and cortex. This is a topic of great clinical importance, which needs special attention.

Afferent input to the *cerebellum* from somatic (and other systems—visual, auditory, vestibular), although well established since the early 1940's (Snider & Stowell; Adrian) has not yet been studied to any extent by the single unit technique. Eccles' and Llinas' studies have been concerned mainly with synaptic mechanisms, investigated mainly through electrical stimulation of fiber pathways, with little attention yet being given to activity of single cells. Thus, there is need for careful unit studies of all systems sending information to the cerebellum. These probably include all afferent modalities, including taste and smell, on which practically no work has yet been done. Even for the forebrain definitive studies on taste and smell need to be carried out with the unit recording technique.

Vision: The single unit studies of Hubel and Wiesel on the visual cortex have attracted wide attention and have demonstrated the power of single unit studies in defining response characteristics of neurons at different levels of the central pathway and in showing how responses differ from periphery to highest centers.

Audition: Much work has been done and is underway on this system with extracellular recordings of unit activity (Kiang; Rose, Hind *et al*), ranging from the auditory nerve through all levels of the brainstem to cerebral cortex and cerebellum.

In spite of the extensive work already done in vision, audition and somesthesis, there are many challenging problems facing us. In all these systems it is no longer possible to think only of primary receiving areas. Each system has a number of cortical receiving areas, as has been defined for somatic and auditory systems by Woolsey and associates and for the visual systems (Allman, Kaas & Woolsey). Aside from the observations of Hubel & Wiesel on the characteristics of single cell responses in striate and parastriate cortex of cat and by Mountcastle and by Paul on the postcentral gyrus of monkey, very little has been done to establish the functional properties of these multiple areas by any method. Parallel studies on the anatomical connections of these systems are in progress in various laboratories, notably by Powell and associates at Oxford. Since it seems philosophically certain that the human brain must be organized in a similar manner, though surely in more elaborated detail, it is of the utmost importance for understanding the human brain that experimental and related human studies be pushed vigorously in future research.

Of great importance in the conduct of single unit research on the afferent systems is the use of *computers* in stimulus control and data analysis. This has been done particularly successfully in audition (Kiang; Hind, Rose *et al*) and in somesthesis (Mountcastle), but there has been minimal use as yet of computers in mammalian visual research.

Motor systems: Outstanding success in the analysis of motor function in precentral motor cortex and the pyramidal pathway and in frontal eye fields of the monkey with single unit recordings has been achieved by Evarts and associates in unanesthetized, behaving monkeys. This methodology promises that much fruitful work will be accomplished through its extension to study of all systems of the brain. It can be expected to play a crucial role in analysis of the functions of the several subareas, of the main afferent systems and of the motor functions of the supplementary motor area and the efferent pathways leaving the somatic sensory areas (S I and S II), the visual and the auditory areas. Out of such studies can be expected to come a better understanding of the roles of cortical and other levels of neural organization in the management of *behavior*. Here again computers can be expected to play an important role, especially in relating the activity of many single units in any given center and in different centers. A present limitation of single unit studies is the fact that the unit being studied is but one of perhaps thousands or hundreds of thousands of cells discharged by the stimulus or participating in a particular motor act. Some success in recording simultaneously from several cells has been achieved (Gerstein and others) and more can be expected with further development of multiple recording methods and computer application to the problem.

There is also need to relate single unit studies more precisely to the overall pattern of localization within the various levels of the system being studied. All too commonly, e.g., single unit studies are made without reference to the site within the cortical localization pattern at which the recording is being made. It would seem of importance to define the recording site as precisely as possible. All too commonly investigators proceed each with his own method without reference to results obtained with other procedures. This fact has been obvious all too long in the almost complete isolation from one another of studies on the "specific and nonspecific systems."

Autonomic nervous system: Little has been done to date with single unit recording methods in the study of the autonomic nervous system, except in peripheral ganglia and in some studies of input to the medulla from receptors in the cardiovascular system. Unit studies on the intermediate cell column of the spinal cord and at all higher levels of the nervous system related to the autonomic system should prove fruitful and important in understanding the functioning of this system.

Neuroanatomical studies

The past decades have also seen striking increases in our knowledge of the structure of the nervous system. These include results on the ultrastructure of the nervous system with the electron microscope, findings which challenge the methods of the neurophysiologist in relating his findings to the structure of the brain. This area of research both for the study of normal and pathological material seems unlimited.

Studies on connectivity within the CNS have also received much attention, outstandingly through improvements in the silver staining methods as elaborated by Nauto, Fink and Heimer. Certain inherent difficulties exist with these methods which limit their great usefulness. One of these is the problem of fibers of passage which are interrupted by lesions placed in deep nuclei of the brain. A solution of this difficulty seems to have been achieved with injections of radioactive leucine and its possible extension to other compounds (Cowan *et al*). These compounds appear to be taken up only by the cell bodies, where they are incorporated into the cell proteins and then passed down the axons and out the dendrites toward sites of contact with other cells in two phases, a fast and a slow. The materials are not incorporated into fibers of passage nor by cells damaged by the injection. Much interest is developing in this method and one can expect to see the entire nervous system reexamined with this technique in the coming years.

The area of *neuroembryology* with its use of radioactive markers, as exemplified by the studies of Sidman and others, is an important and active one and one can expect to see continued activity in this field.

These are but a few of the areas of research in basic physiology and anatomy of the nervous system which could be cited to show the vigor of current investigations in the brain. In spite of the many basic studies accomplished and now in progress, there has never been a vista of more to be done than at the present time. In the long view, such studies promise much for understanding the normal and pathological neurological and behavioral functioning of the nervous system and rational treatment of neural dysfunction.

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Appendix XIV

Neuropathology for the Seventies

Thanks to the recruitment, within the past few decades, of such tools as electron microscopy, enzyme histochemistry, radio-autography, visible immunologic tracers, tissue culture, etc., anatomical science has advanced rapidly. New avenues of research have opened up with such rapidity that prediction of future trends is hazardous at best. With regard to research on disease, however, it is reasonably safe to predict that the major trend will be toward chemical pathology. This implies the primary definition of a lesion in a structural sense, then physical isolation of the abnormal elements, followed by chemical analysis. Experimental models of the pathologic process will undoubtedly be used heavily in this type of work.

An extremely important aspect of preliminary nonpathologic study will concern topographic variations in the nervous system. We must learn how neurons in one part of the brain are different from those in another as to their composition and metabolism, in order to explain their varying susceptibility to disease. Cell isolation techniques applied to anatomic regions will undoubtedly be essential to [illegible] studies.

The individual pathomechanisms of the cell types—neurons and glia—primary to the nervous system must be explored in great detail in order that these changes be correlated with those cellular modifications found in disease. The mechanisms of synaptic pathology, axonal dystrophy, astrocytic glycogenosis, neuronal chromatolysis, etc., will be explored to the point of full understanding.

The problems relative to vascular diseases and to brain tumors will probably be solved largely on the basis of work done on extraneural tissues. That is, studies of atherosclerosis, hypertension, and lipid metabolism in general will be applied to carotid and cerebral vessels. Information concerning tumor viruses and tumor immunity will be applicable to gliomas and meningiomas.

Traumatologic research seems to me not to be very promising in the practical sense. Pathogenesis will have little or no bearing on treatment, and so the most important research here (leaving aside therapy) is on preventive measures.

Personally I have little doubt but that aging in general, and cerebral aging in particular, is going to become an enormously important subject in the very near future. It is so obviously in the self-interest of the country as a whole, given its aging population among whom is to be found an increasing proportion of seriously disabled. Sufficient information has now been accumulated on basic processes so that a large scale assault can be mounted in regard to structural, chemical, immunologic, and infectious (perhaps slow-virus) aspects. Some of this work may be very expensive, requiring numbers of large animals, especially primates, maintained for many years.

The field of slow viruses is widening rapidly. Their significance in many of the disorders currently without etiologic explanations will undoubtedly be explored. Certain members of the myxovirus group are apparently intermediates between the usual virus and slow ones, and the particular characteristics of those strains which are of the latter type must be identified and characterized to explain their different reactivity.

The demyelinating disorders of myelinoclastic type have come under intense immunologic, morphologic, and epidemiologic investigation in recent years. The evidence of an immune mechanism following viral initiation is becoming very strong, and major breakthroughs can reasonably be expected in the not too distant future.

Neuroendocrinology has been firmly established by the anatomists and physiologists. Its broad implications to disease must now be studied by chemists and other workers.

Among the storage disorders and leukodystrophies the emphasis will surely be on treatment, now that pathogenesis and etiology have been explained. Animal analogs may well be useful in studies of replacement enzymes and genetic engineering.

In addition to the many new ways of creating teratologic models, more fundamental embryologic methods have been developed recently. Together they make the field a much more exciting one than allowed by the formerly descriptive tools. As a result, research efforts will increase in the general field of birth defects.

A Nobel Prize has been awarded for work on neurotransmitters. Applications have been found in movement disorders, and in such fundamental processes as regeneration in the central nervous system. This field, too, will be highly productive with the combined efforts of chemists, morphologists, and physiologists.

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Appendix XV

Neurochemistry

Development and Status of Neurochemistry

As a recognized subdiscipline, neurochemistry is the newest of the neurological sciences although its roots are ancient and some of its major landmarks were established by the end of the nineteenth and early twentieth centuries, witness the pioneering work of Johannes Thudichum on brain structural components published in treatise form in 1884, and the discoveries of adrenalin by Elliot in 1904 and of acetylcholine by Loewi in 1921. Many important investigations on the metabolism of nerve and brain and on the structure of complex lipids took place between the two World Wars, but it is fair to state that neurochemistry as a field of special endeavor has had its essential development in the past quarter century, both in this country and abroad. Indeed, the term itself had scarcely been used prior to 1950.

The growth of neurochemistry has been remarkable and world-wide. In America this has been virtually determined by the support from the National Institutes of Health, but neurochemistry's growth rate has even exceeded that of federal financing, partly as a result of recruitment of investigators from general biochemistry and other neurological sciences. A number of developments may be cited as indicative. Departments or divisions of neurochemistry have appeared in universities, hospitals and research institutes; a few professorships have been established. In 1955 an international *Journal of Neurochemistry* was founded whose pagination has in the interim increased fivefold. An International Society was founded in 1967 followed by an American Society of Neurochemistry in 1970, now with a membership well over four hundred. Numerous symposia, textbooks and monographs are further evidence of neurochemistry's coming of age.

There is little mystery concerning these developments. They reflect and are part of the spectacular advances in general biochemistry and molecular biology that also have occurred during the post World War II era. They are indicative of the growing conviction that in neurology, as in all of bio-medicine, biochemistry and biophysics are becoming the common languages of the substituent sciences, and that the main thrust both present and future towards fuller understanding of biological systems and the changes they undergo in disease must be in terms of analyses of molecular and atomic relationships and events.

The principal areas of investigation that collectively have come to comprise the discipline of "neurochemistry" include the following:

Structural Neurochemistry. The original impetus in neurochemistry was directed towards the organic structure of the characteristic complex lipids that constitute a major fraction of the total solids of brain and nerve. Much progress has been made in recent years, especially in knowledge of the glycerophosphatides and the special subclass of glycolipids known as gangliosides which form part of the composition of neuronal plasma membranes. The principles and techniques of protein chemistry have been actively applied to develop a roster of brain proteins (including glycoproteins and proteolipids) and undertake analyses of their infrastructure, conformational properties and functional roles. The devising of methods for subcellular tissue fractionation, and particularly in brain for purified preparations of myelin and plasma membranes, has enabled direct analysis of the lipid and protein composition of these significant substituents and proposals for theoretical models of their molecular architecture. Advances are currently being made in understanding of the molecular fine structure of fibrillar elements as well, such as neurofilaments and neurotubules. Beginnings have been made in isolation and analysis of brain nucleotides and the machinery for protein synthesis and degradation. A provocative but still unresolved series of problems has been addressed having to do with the possible roles of RNA and protein in stabilization processes related to learning and long-term memory storage.

Metabolism. Both *in vivo* and *in vitro* studies on the metabolism of brain, ganglia and peripheral nerve can be traced back to the embryonal stages of neurochemistry after World War I. Again, however, definitive knowledge has been largely obtained in the last quarter century. Sophisticated techniques for measurement of cerebral blood flow and metabolic rate, both general and regional, have led to systematic analyses of *in vivo* brain energy metabolism in relation to changing functional status in both experimental animals and man. *In vitro*, the principles and techniques of tissue metabolism have established in full the molecular transformations and enzymology responsible for energy yielding reactions in brain and have shown that these are essentially similar to those in other organs and tissues of aerobic species, though with a perhaps especially significant role for the hexosemonophosphate shunt pathway. Thus it can be stated that how the brain meets its exceedingly high requirement for oxidative energy input is quite completely understood. Explorations of current frontiers concerned with energy utilizing mechanisms for synthesis of complex lipids, proteins and special neurogenically active compounds are also in full progress. Of particular importance and significance is the area overlapping somewhat the field of neuropharmacology concerned with elucidation of the anabolic and catabolic phases in the turnover of biogenic amine neurotransmitters.

Histo- and Cytochemistry. The uniquely complex anatomical composition of the nervous system has made it especially important to apply to it the full repertoire of principles and methods of correlating biochemical knowledge with histology and ultrastructure. It is of interest that neurochemists have provided some fundamental technological developments in this area applicable to all biology (e.g. methods for separate isolation and quantitative microanalysis of single nerve cell bodies and satellite neuroglia; techniques for localization of biogenic amines by fluorescence microscopy). All of the known procedures for tissue and subcellular localization of biochemical structural components and metabolic systems (these include particularly light and electron-histochemistry, quantitative microchemistry for microgram-sized tissue samples and fractionation procedures for preparation and macroanalysis of subcellular components) have been widely applied, and a large body of information obtained on the molecular architecture of brain regions and cell types. Thus, an elementary description and understanding of organized nervous tissue as a physicochemical system is beginning to emerge. Notable advances towards this goal have been recent partially successful attempts to isolate and analyze differentially purified preparations of nerve cells and glia, and the application of biochemical methods to analysis of separate brain cellular species cultivated *in vitro*.

Chemical Pathology. Most of the foregoing lines of investigation have been applied in comparative fashion to selected problems in nervous and mental disease. Included have been clinical studies on human subjects, mainly analyses of body fluids but occasionally also of cerebral biopsy specimens or therapeutic extirpations during craniotomy. In such ways many studies have been made on the structural chemical and metabolic aspects of degenerative, deficiency, neoplastic, metabolic, toxic and inherited neurological diseases in man. Some notable achievements have resulted leading to identification of biochemical lesions and rational improvements in therapy in such diverse conditions as Wilson's disease, thiamin depletion syndromes, paralysis agitans and a number of genetically determined mental deficiencies. Nor has the biochemistry of experimental neuropathological models been neglected. Examples have included animal mutants with neurofibrillary degeneration. In efforts to understand the nature and genesis of the chemical pathology of myelin in multiple sclerosis, remarkable insights have been obtained concerning the immuno-chemical mechanisms involved in the pathogenesis of the lesions in experimental allergic encephalomyelitis with implications for possible autoimmune neurological disease in man. The list could be extended, for the range of biochemical neuropathology is now considerable, the field is very active and the potential insights and benefits for neurological medicine are great.

Foreseeable Future Trends in Neurochemistry

Since neurochemistry is, for the most part, a form of applied biochemistry, its future course will, in general, parallel developments in molecular biology and biochemistry. However, the complex interrelations of cellular components in the nervous system and the critical role of excitable membranes and their enveloping sheaths highlight the special importance of sophisticated cytochemistry and membranology in normal, developing and pathological nervous tissues. To predict the course of any science is hazardous, but it seems fair to assume that neurochemistry will have important developments in most of the following areas of contemporary interest:

Molecular Genetics. Investigations by outstanding molecular biologists are already under way on the transcription-translation process from DNA to specific protein in *in vitro* model systems of neurons and neuroglia. Such studies together with the related use of physical chemistry for exact analysis of individual protein structure and enzymology will provide the foundations for the molecular biology of the intact, developing and mature brain and the eventual possibility of modifications through genetic engineering. In view of the particular importance of hereditary factors in neurological illness, the remote vistas are provocative indeed though not without potential social hazards.

Structure and Function of Membranes. The exact molecular architecture of the neuronal plasma membrane must be determined for understanding of the coupling of cytoplasmic energy yielding systems with ion pumping and establishment of potential gradients, and the exact occurrences during sequential changes in polarization states. Closely related are the molecular interactions between excitatory and inhibitory neurotransmitters and their receptor sites in the post-synaptic membrane. These will be the meeting places of the neurochemist and the electrophysiologist and the pathway to precise knowledge concerning the biophysics of the neuronal message.

Biological Relationships of Neurons and Neuroglia. Biochemical procedures will continue to be developed and utilized for establishing the structural chemical and metabolic interactions between neurons and their glial envelopes, including myelin, and these in turn with the manifold problems related to transport mechanisms in the brain (the blood-brain-barrier, cerebrospinal fluid turnover, etc.). From such investigations, which must be in close collaboration with the neuroanatomist, it can be anticipated that many insights will be gained concerning how the several cellular constituents of the brain participate in the economy of the whole organ and contribute to such elusive problems as the trophic function of neurons and the satellite role of glia. Again, the potentials for neurological medicine and neurosurgery are very great especially with regard to both local and extracranial disorders that result in disturbances of cerebral homeostasis.

Miscellaneous. Many other lines of development in neurochemical research can be anticipated more or less *pari passu* with the progress of general biochemistry. For example, a rapidly expanding subject at the present time is delineation of the modes of intracellular action of hormones and the manner in which these are mediated by cyclic mononucleotides. In the nervous system, dramatic effects of neurotransmitters on the turnover of cyclic AMP suggest that important developments lie ahead on the actions of biogenic amines on nerve cell metabolism as well as locally at the post-synaptic membrane. Indeed, knowledge of the metabolism and action of amino acids as well as indole and catecholamines is progressing rapidly and is certain to have important consequences for neurology. Other areas due for major expansion following promising beginnings are comparative investigations on the biochemistry of brain during its full range of development and maturation, and on clinical neurochemistry and biochemical neuropathology. The implications and importance of all such forms of comparative neurochemistry for neurology and psychiatry are selfevident.

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Appendix XVI

Biomedical Behavior Research

INTRODUCTION

The diversity of modern behavior research reflects the evolution of theoretical psychology from a stage in which it was dominated by a few doctrinaire and conflicting conceptual frameworks to one in which the complementarity of the traditional schools of thought has been recognized. There were, of course, some approaches to behavior research before 1950 that were independent of such bias, such as those of Hobhouse, to mention an early example, of D. K. Adams, Lashley, Kluver, and of the ethologists, but it was not until roughly mid-century that the dominance of behaviorism on the one hand and field theory on the other, and the sharp distinctions between them, began to fade. As for the present and the future, we are witnessing the beginnings of rather startling connections between our more flexible learning theory and certain areas of anatomy, physiology and chemistry and also the development of an enormous increase in the interface between behavior research and the practical interests of human welfare.

Gross Anatomical Substrate Research

The behavioral significance of the cerebral cortex, at least in broad outline, has been established by cortical ablation studies in many species. The pioneering work of this sort in primates was that of Bianchi and of Jacobson on the frontal cortex, and Kluver and Bucy on the remarkable effects of bilateral temporal lobectomy. Subsequently, many others have carried out similar studies leading to our present general concepts of the frontal cortex as mediating delayed-response type functions and response inhibition, the lateral temporal cortex concerned with complex visual discrimination, the hippocampus with memory, and the parietal cortex with tactile and proprioceptive discrimination.

While this general scheme of cortical function in behavior will always remain a monument to the stamina and ingenuity of a great many investigators, there is considerable room for further refinement in cortical ablation research. A recent study by Mishkin is an example of the possibilities. In an effort to determine the pathway from striate to temporal cortex for the mediation of a visual discrimination task in monkeys, he succeeded in destroying the prestriate cortex completely. By strategic combinations of this lesion with crossed and uncrossed striate and temporal lesions, with and without callosal section, he was able to establish that the prestriate cortex is an obligatory component of the processing pathway from the visual to the temporal cortex, and that transmission to the opposite hemisphere is via the corpus callosum. Participation of subcortical structures, such as the thalamus, as primary or alternate pathways from one cortical area to another was excluded.

It is very likely that the general trend of finer analysis of the neocortex, exemplified by this study of Mishkin's, will be to blur the traditional hierarchical distinctions between association and sensory projection cortex. While processing of sensory data in projection cortex may be preliminary, and without local access to all relevant stored experience, it is probably no less complicated than that in association areas.

The limbic cortex, the amygdala and the hypothalamus have also been studied extensively by means of behavioral-ablation and electrical and chemical stimulation techniques in various combinations. The general nature of the role of these structures in affective behavior has been fairly well established, but much remains to be explored, for example, the relation between them and the endocrine system and to the extent to which our present knowledge of the anatomical substrate of emotion may be integrated with such attractive theories of the role of emotion in learning as that explored by O. H. Mowrer.

The question of the behavioral significance of subcortical gray matter has evoked considerable interest in recent years, but progress in the elucidation of this question has been slow by reason of the technical difficulties involved in producing deep lesions which are accurately placed and at the same time large enough to destroy anatomical units completely. Certain notions about subcortical structures have come more or less as by-products of the cerebral commissurotomy research of Sperry, Mishkin and others. The results of these have been negative, in the main; that is, they suggest that subcortical structures are concerned to a minor extent, if at all, with behavior at the level of complex discrimination learning and memory. There is great need to round out these inferences with direct data on the behavioral effects of precise and complete lesions in the deep cerebral nuclei. The data available at present are fragmentary and inconclusive. Thus, destructive lesions in the caudate nucleus in monkeys have been found by Rosvold, Delgado, Mishkin and others to reproduce the effects of frontal cortical resection on delayed-response and on the ability to alter responses in accordance with the requirements of changing stimulus situations. It is not yet clear, however, whether these effects are from damage to the caudate or from interruption of fiber connections between the frontal cortex and other deep structures, such as the thalamus, which pass through the caudate. In regard to the thalamus, there is precious little to go on, so far as complete lesions of any of its nuclear subdivisions are concerned. In the very small number of monkeys in which complete bilateral destruction of the dorsomedial nuclei has been accomplished, impaired delayed-response and a perseverative defect in a learned tool-using task have been observed, but these findings need confirmation in a larger number of animals.

The commissural transection research already alluded to is still another area of ablation-behavior research which is of the utmost importance in its own right, apart from any implications it has yielded for the functional significance of subcortical structures. The administration of cleverly designed behavior tests to "split-brain" animal preparations, and to human patients in whom major interhemispheric connections have been interrupted by disease or by therapeutic surgical intervention, has richly extended the observations of the astute pioneers in neurology on aphasia, apraxia and the non-dominant parietal lobe syndromes in man. What is emerging from this work is greater understanding of the phenomena of cerebral dominance, of the neurological basis of language, and of the substrate for concepts of mechanical and spatial relations between objects. Very tangible applications of this new knowledge may be expected in the treatment of aphasia resulting from stroke and head injury, in education and in the management of special learning disabilities in children, such as specific dyslexia.

Neurological Approaches in Behavior Research

The development of increasingly refined electrical stimulating and recording techniques, and of computer analysis of data, have made possible the beginnings of an "ultra-structural" physiology of perception and learning. Another advance in methodology that has brought anatomy and physiology into a more rigorous relation to behavior has been the use of natural stimulus situations, rather than electrical stimulation. Thus the visual system at all its levels has been studied in many species by means of multineuronal and single unit recording during presentation of actual visual stimuli. The seemingly hopeless complexity of the mammalian visual cortex has yielded up at least a few consistencies on being examined in this way. It has been found, for example, that certain neurons respond specifically to certain qualities of visual stimuli, such as brightness, contour-contrasts, or movement and not to others. Similar sorts of constancy have been known in the auditory system for a longer time and very recently the vestibular system has been made accessible to this kind of analysis by means of ingenious devices for bringing forces of acceleration to act on the end-organs during single unit recording in the brain. As a consequence of these techniques we can anticipate a significant increase in our understanding of the nature of the coding processes by which information from the exterior is represented in the nervous system. Orientation in space, signal detection, and prompt, accurate responsiveness are preceptual functions of the nervous system which become both more vulnerable and more crucial under the extreme conditions of high speed auto and air travel and of space flight, conditons which played no part in the biological evolution of the brain. The mechanism of these functions, which are so crucial to safety, and how they are influenced by such factors as fatigue, training, drugs and age obviously demand extensive investigation.

Similar electrical techniques are now being used to monitor the activity of nerve cells in the cortex and in deep gray matter of the brain during the learning of discrimination and delayed-response tasks in the conscious, freely-moving animal. Recently, some fairly consistent alterations in the firing pattern of nerve cells in the dorsomedial nucleus of the thalamus in monkeys have been observed to coincide with the learning of a delayed-response task. This observation, and others like it, remain to be verified and they are far from being incorporated into any coherent scheme of the neurology of learning but they do represent the beginnings of a neurophysiological analysis of integration at a behavioral level.

Together with this rather intrepid exploration of the mammalian brain during behavior, there has been, during the past ten years, an increasing number of anatomo-physiological studies of the simpler nervous systems of birds, reptiles, fish and invertebrates, including the octopus, crayfish, insects and mollusks. Habituation, that rudimentary form of learning which can be observed at least as far down the animal scale as the Coelenterata, is not the only form of behavior available for study in simpler animals. The anatomical substrate of complex discriminations and of memory, for example, have been elegantly worked out in the octopus brain by J. Z. Young. The life-work dream of the anatomist, C. J. Herrick, to establish a comparative neurology of behavior is now being accomplished not by one man, which Herrick learned was impossible, but by a great number of neurobiologists who are examining behavioral correlates in simple nerve nets and ganglia as a matter of intrinsic interest, and for the elucidation such studies may provide for the understanding of the basis of ideational behavior in man.

From a more immediately practical viewpoint, it may be noted that clinical electromyography, nerve conduction velocity testing and electroretinography, all currently in wide use as helpful diagnostic techniques in human disease, have been made possible by basic neurophysiological research and instrumentation. One might well ask what does the diagnosis of muscular dystrophy, peripheral nerve injuries and eye disease have to do with behavior research? Natural phenomena do not coincide with the borders of traditional disciplines and scratching a surface here and there, as opportunity suggests, sometimes uncovers a new correlation of great significance. It was in this way that H. Meltzer, a psychiatrist, discovered that the muscle enzyme, creatine phosphokinase, which is elevated in the serum of patients with muscular dystrophy, is also increased in schizophrenia. Following this lead, Meltzer found abnormalities in the electrical activity of muscles on electromyographic examination of patients with schizophrenia and also alterations in the structure of their muscle fibers when examined with the electron microscope. It remains to be seen, of course, whether these findings represent secondary phenomena, related to such factors as nutritional deficiency or drugs, or to a fundamental metabolic disturbance which causes schizophrenia. In any case, this is a lead that cannot be ignored.

Another application of basic instrumentation to human disease is that of cortical evoked response studies. Auditory evoked responses have already been used for some years in the early diagnosis of hearing loss in young children who might otherwise be regarded as mentally defective. More recently, there has been a growing interest in the study of the latency and form of cortical evoked responses to visual, auditory and cutaneous stimuli in focal and diffuse brain disease, mental retardation and mental illness. Although this work is still in an early stage of development, certain observations have been made which suggest that the evoked response technique will eventually be widely used as a non-invasive, non-traumatic diagnostic procedure in a variety of disorders of the human nervous system. The fact that correlations between abnormalities of the evoked response and disease may be largely empirical does not detract from the potential usefulness of the technique. This has been true of a great many diagnostic test procedures in medicine, one outstanding example being electroencephalography. On the other hand, some of the recently reported observations on evoked responses have been rather provocative and suggestive as clues to the nature of neural processes related to attention and intelligence. In one recent study, for example, it was found that the late positive component of the visual evoked response was observed consistently only when the stimulus provided information, and the amplitude of the response varied depending on the meaning of the stimulus. Several studies have shown that the late components of the response are smaller in amplitude and longer in latency in dull subjects than in normal controls and the asymmetry between the dominant and non-dominant sides, which is characteristic of normals, is less conspicuous or absent in dull subjects. Short response latencies in newborn infants appear to be correlated with ability to walk at the age of one year and with the early development of speech.

It seems clear that the development of this technique as a diagnostic and research tool should be continued. Further experience is needed to establish dependable criteria of normality. It would also seem eminently worthwhile to study the characteristics of habituation of the evoked response to repetitive stimuli over a wide range of age in health and in cerebral disease.

Biochemistry and Learning

By analogy with genetic and immunological "memory," it has been suggested that biochemical events in nerve cells, in the form of molecular rearrangements, may be related to learning and memory. Research in this area, for example, has shown qualitative changes in nucleotide base composition, as well as increased amounts of RNA in the brains of rats during and after learning and in response to exposure to stimulating environments as compared to relative isolation. When a learning task requires special activity in a specific functional system, it has been possible to demonstrate that the alterations in RNA composition and amount are localized in that system. Conversely, when the synthesis of neuronal RNA is blocked by actinomycin-D or puromycin, or when the formation of "fraudulent" RNA is induced by 8-azaguanine, learning is impaired. Enhancement of learning ability has been reported in rats after intraperitoneal or cisternal administration of RNA extracted from the brains of trained rats, replicating similar earlier observations on the effects of feeding trained flatworms to naive ones. Recently, the transfer of a very specific item of learning, i.e., dark avoidance in rats, by a specific polypeptide extracted from trained rat brain has been claimed. The implication of observations such as these is that information storage takes place by means of coding in the structure of macromolecules. Perhaps, however, the existence of the publication, "The Worm Runner's Digest," is a healthy sign that the investigators in this area are aware that Professor Ralph Gerard's famous remark about "twisted thoughts" and "twisted molecules" does not exclude the likelihood, or at least the possibility, of one being many steps removed from the other. Further work is required based on such questions as how much do the effects of learning on neuronal RNA differ from the well-known increases in regional blood flow, oxygen and glucose utilization, and uptake of metabolites and drugs, which follow stimulation of specific brain structures? How much, and in what ways, do the effects of suppression of RNA synthesis differ from those of glucose and oxygen deprivation, of other toxins presumably less specific in their action than puromycin and of depressant drugs?

Mental Illness

During the past 15 years, substantial progress has been made in the management of schizophrenia and the affective psychoses. During the same period, the mechanisms of action of the new drug therapies, all of which were originally developed empirically, have been explored and these investigations have prompted a series of remarkable biochemical hypotheses concerning the etiology and pathogenesis of mental illness. While current therapy has greatly simplified the management of mental illness and has reduced the costs involved in long-term hospitalization, the results are by no means so satisfactory that questions of etiology may now be relegated to the realm of the academic or to "pure science." Reliable figures for the prevalence of depressive psychosis are difficult to obtain for a variety of reasons but for schizophrenia, which is disabling for enormously longer periods of time—often extending tragically over entire adult life-times-prevalence estimates in modern European and American populations generally range between 0.3 and 1 percent.

There have been two principal developments in recent years which have led to renewed interest in an organic basis for schizophrenia as opposed to psychological and socio-cultural theories. One of these has been the revival of the genetic hypothesis. The experience of the early alienists at mental institutions on visitors' days, which convinced many of them that dementia praecox was a familial disease, was discounted long ago and the well-known studies of familial incidence by Kallmann in the 1940's tended to be rather severely criticized on methodological grounds. During the past five years, however, Kallmann's work has been generally confirmed by more rigorously controlled studies by several investigators, notably Heston, Rosenthal and Karlsson. At the present time it would seem that Kallmann's starkly impressive figures for concordance in separately reared monozygotic twins have been validated and they have no simple explanation other than inheritance. Heston's recent review of twin studies indicates that 46 percent of monozygotic twins of schizophrenic patients also become schizophrenic and most of the remaining 54 percent develop schizoid personality disorders.

The other major development in the current reawakening of interest in organic etiological factors in mental illness has been the recent active research on the biogenic amines in the central nervous system, and on the chemical and metabolic relationships between these substances and most of the known psychoactive drugs. Perhaps Professor Gaddum's extravagant remark that serotonin may be what keeps us sane can be excused by reason of the truly spectacular advances that have been made in the past 15 years in our knowledge of the metabolism and possible functional significance of the catecholamines and the indolealkylamines in the central nervous system. The happy union of histochemical fluorescence techniques, extraction and assay methods, subcellular fraction studies and electron microscopic autoradiography has led to the identification and localization of these compounds in axon terminals in the brain and to convincing evidence for regarding them as central neurohumoral transmitters. It became only natural to wonder if schizophrenia was a result of some abnormal metabolic pathway by which, say, serotonin or its natural precursors were transformed into something resembling such psychotomimetic agents as LSD or yohimbine, both of which share the indole nucleus with serotonin, or into something similar to bufotenine, which is identical with serotonin except for two methyl groups attached to the amine nitrogen; or whether abnormal 0-methylation of dopamine or norepinephrine might occur and yield compounds similar to mescaline, a tri-methoxy derivative of norepinephrine. It was also natural to think that a deficiency of central catecholamines or serotonin, or both, might be the cause of depressive psychosis, since reserpine, which induces depression, depletes brain amines while the monoamine oxidase inhibitors and the tricyclic antidepressants, which are highly effective in the treatment of depression, increase the effective concentration of central amines.

The obvious systematic observations on patients, which are suggested by these biochemical considerations, have begun. Urine, blood and spinal fluid levels of the biogenic amines and their metabolites in depressive psychosis and schizophrenia have been studied and correlated with treatment and clinical status. Abnormal metabolites have been sought in body fluids. On the theory that 0- and N- methylated amines are causative agents, the effects of the administration of methyl-donors and of methyl-donor antagonists to schizophrenic patients have been explored. The content of indoleamines in the brains of a few depressed patients has been determined following death by suicide. Thus far the results of such studies have been quite variable and inconsistent. This might be taken to mean that the questions asked by current clinical investigation of mental illness are too simplistic. They probably are but it is well to remember that our knowledge of the functional chemistry of the brain is in its infancy, that the time for subtlety has not yet arrived. There are many obstacles to be overcome in the future course of biochemical research on mental illness but there is no reason to believe they are totally insurmountable. Among them, the principal ones have become obvious very quickly: the relative inaccessibility of human brain tissue for analysis, the uncertainty about the major ultimate origins (central or peripheral) of the various amines in body fluids, the complicating influence of nutritional state and medication in patients under study and the relative lack of uniform and objective criteria for diagnosis.

Mental Retardation

During the present century there has been a remarkable advance in the classification, understanding and management of the diverse forms of mental retardation but, in view of the number of persons affected by causes that remain unknown, our present knowledge must be regarded as a beginning. The several varieties of cretinism, the sub-types of the lipid storage diseases of infancy and childhood and the inborn errors of aminoacid and carbohydrate metabolism have been differentiated clinically and, to a greater or lesser extent, biochemically also. As a result of clinical, biochemical and pathological research on these disorders, we can now minimize or prevent mental retardation in several of them, including phenylketonuria, galactosemia, the congenital hypoglycemias, maple sugar urine disease, cretinism and Wilson's disease. In all nine of the known lipid storage diseases of the brain, the specific enzymatic defects have been discovered, and it is now possible to identify the presence of each of these diseases in the fetus by chemical study of desquamated cells in amniotic fluid and to interrupt pregnancies which yield children with hopeless and ultimately fatal disease of the brain. Biochemical studies of the body fluids and tissue-culture preparations of skin fibroblasts or blood cells have made it possible to detect heterozygous carriers of the lipid storage diseases, so that wellfounded genetic counseling is now possible.

It is remarkable how sometimes the pace of discovery in a field in which the problems seem hopelessly intricate may exceed that in a related area, far simpler in its stage of development and sophistication. By 1952 it was possible to say, from Wilkins' x-ray diffraction work, how many Angstroms lay between each full turn of the DNA helix and it was in 1953 that the double helical structure of the DNA molecule was suggested by Watson and Crick. Yet it was not until 1956 that the normal number of human chromosomes was established as 46 by Tijo and Levan.

This single datum, which is obviously prerequisite for the recognition of any faulty distribution of autosomal chromosomes, was followed quite promptly by the discovery of a triple dosage of one of the pairs of the G group of chromosomes in mongolism by Le Jeune, Turpin and Gautier in 1959. This was almost 100 years after the original description of this relatively common form of mental retardation by Langdon Down in 1866. In 1960 autosomal trisomies were also found in association with two other less common types of cerebral dysgenesis associated with mental retardation—18 trisomy, and trisomy of one of the pairs of the D group, the latter having as its most common phenotypic expression, arhinencephaly, a cerebral malformation described in 1882 by the anatomist, Kundrat.

Down's syndrome occurs in 1.6 to 2 per 1000 births, with a long-known substantially greater incidence in infants born to mothers 35 years of age or older. It constitutes 10 percent of the institutionalized mentally retarded in this country, of which there are approximately a half million. The age-linked factors in the cytoplasm of the ovum which are responsible for the chromosomal maldistribution of Down's syndrome remain unknown, nor, in the majority of instances, does our recently acquired knowledge of this faulty distribution provide any practically feasible way to detect Down's syndrome in the fetus or to determine the likelihood that individual women will produce offspring with the disorder.

Certain deviations from the generally small recurrence risks of Down's syndrome, which have been known for a long time, have recently been accounted for by chromosomal aberrations other than G trisomy. The most common of these, comprising perhaps 5 percent of cases, is G translocation resulting from a translocation carrier state in a normal mother. The others are G trisomy from maternal G trisomy/normal mosaicism and probably G trisomy as a rare familial aneuploidy. These varieties of Down's syndrome are not related to advanced maternal age and their recurrence rate may be very high. In G-D translocation, for example, the theoretical and observed initial and recurrence risks are one-third, regardless of maternal age, while in the less common G-G translocation type the risk has been observed to be 100 percent. It is in these varieties of Down's syndrome that karyotyping should be feasible and useful in counseling younger parents of an affected child and in determining by amniocentesis the status of a fetus at high risk.

During the past decade, karyotyping has been done on a fairly large number of children with mental retardation associated with a variety of congenital somatic anomalies, in an attempt to identify distributional or structural aberrations of chromosomes other than those of the G, D and E groups. Some such children have been found to have partial monosomies or partial trisomies, but in the majority the karyotypes have been indistinguishable from normal. In those with distributional abnormalities, the assortments of somatic anomalies have been so variable that it has proved impossible thus far to link distinctive clinical syndromes to specific chromosomal defects.

Cytological research in relation to mental retardation and behavior disorders needs to be continued. We need more information about the incidence of certain deviations from the usual karyotype in the normal population, in order to avoid attributing abnormalities to normal variations in chromosome patterns. Such an error has apparently occurred in the Sturge-Weber syndrome, and probably also in the recent efforts to link mental deficiency and criminal behavior to the XYY anomaly. The recent studies of Caspersson, Lomakka and Zech, of Stockholm, on the fluorescence patterns of chromosomes stained with quinacrine mustard have produced, for the first time, a rapid method for the positive identification of each of the 22 pairs of human autosomes. This advance will greatly facilitate cytological research in the future. It would be highly desirable to combine biochemical surveys with karyotyping with a view to uncovering enzymatic abnormalities of the type recently discovered in Down's syndrome (excess galactose-l-phosphate uridyl transferase in erythrocytes). Such data, if it becomes available for other forms of mental deficiency associated with chromosomal aberrations, would be of great importance for nosology, diagnosis and pathogenesis and also for our knowledge of specific gene loci.

Congenital syphilis, lead poisoning and maternal German measles are other etiological categories of mental retardation, about which much has been learned and already accomplished from the standpoint of treatment and prevention. The various forms of hydrocephalus remain incompletely understood. It is true that we have come a long way since the 19th century through our increasing knowledge of the physiology of the cerebrospinal fluid, derived from research pioneered by the Scandinavian anatomists, Key and Retzius, and by the American neurosurgeon, Walter Dandy. During the past 15 years, substantial improvement in the prognosis for many children with hydrocephalus has been brought about by increasing refinements in surgical shunting procedures, but a rigorous program of follow-up examinations and shunt revisions is required and there are at least as many in whom the response to such management is not satisfactory, or in whom the associated structural defects in the brain are so severe as to make any therapy futile. Greater insight into the mechanisms of hydrocephalus is needed and this will come only from further research on the embryology of the brain, the effects of a variety of noxious agents, including viral infections, on the developing nervous system and on the dynamics of the exchange of fluid, electrolytes and metabolites between the brain, spinal fluid and blood.

The remainder of institutionalized subjects with mental retardation, and the 5 million or so in this country with milder degrees of mental deficiency who are partially educable and participate to a marginal extent in the life of society, are a heterogeneous group, in the great majority of whom the etiology is unknown. The proportion suffering from the effects of birth injury is probably considerably smaller than in the past, as a result of improved standards of prenatal care and obstetrical practice. A vague fraction is probably represented by a variety of hereditary abnormalities of the brain the nature of which is completely unknown. In what proportion of the entire group factors other than the strictly biological are causative remains to be uncovered. There would appear to be little doubt that emotional deprivation in childhood, stemming ultimately from a variable set of cultural, social and economic factors may lead to behavioral disorders ranging from apparent mental deficiency to sociopathic or criminal personality disorders, but our attempts to identify and sort out these factors have thus far led to ambiguous results. The finding of a higher than average incidence of electroencephalographic abnormalities in prison populations seems slim evidence for organic brain disease as an important cause of criminal behavior. On the other hand, the observation that "many" parents of autistic children are detached intellectuals is rather an inadequate reason for attributing the striking learning impairment of such children to emotional deprivation.

Senile Dementia

A public health problem of major importance also exists at the other extreme of life in the form of senile dementia, which accounts for half the admissions of patients over the age of 65 to public mental hospitals. The general prevalence of this condition is impossible to judge with any confidence but everyone would agree that few families escape the emotional and financial burden of the care of an elderly member, claimed by a hideous process of mental deterioration.

In assessing our knowledge of this disorder and the likelihood of developing means of prevention and treatment in the near or remote future, a crucial consideration is the controversial relationship between senile dementia and Alzheimer's disease, the most common of the "presenile dementias". In the great majority of patients with senile dementia, the pathological changes in the brain, although less extensive, are qualitatively the same as those of Alzheimer's disease. That the two conditions are identical, therefore, or at least share common pathogenic factors, is a plausible hypothesis. The consolidation of Alzheimer's disease as an entity required some 20 years of clinical and pathological study following Alzheimer's original description of the argyrophilic "senile" plaques in the cortical neuropil, and the similarly argyrophilic fibrillary tangles in the cytoplasm of nerve cells in his patient in 1906. The presence of amyloid in the plaques has been known since 1927, when it was discovered by the Belgian neurologist, Divry, but the significance and origin of this material remain completely unknown. During the past ten years the electron microscopic studies of human biopsy material by Terry, Gonatas and others have elucidated to some extent the vexing questions of the origin and composition of senile plaques and neurofibrillary tangles in Alzheimer's disease and senile dementia. These observations suggest that the plaques are made up of clusters of degenerated neuronal processes, while the fibrillary structures in the perikarya appear to represent an abnormality of a cytoplasmic organelle, the microtubules, which are presently thought to function as mitotic spindles, as internal supporting structures which maintain the shape of cells and perhaps also, from recent work by Paul Weiss, as minute channels for the flow of material distally from the cell body to the terminal processes of neurons.

If even the intermediate goals on the road to prevention and treatment of senile dementia now lie in vague and dimly perceived directions, they were nowhere in sight ten years ago. Among the studies that require carrying forward are the further characterization of microtubular protein, its metabolism and the alterations which are produced in it by spindle-inhibiting toxins; histological and ultrastructural examination of non-neural tissues in Alzheimer's disease and senile dementia, with special reference to non-neural microtubular alterations; the production of analagous changes in experimental animals by toxins; and, on the clinical side, large-scale epidemiological surveys on senile dementia of the type already done on Alzheimer's disease in Switzerland and Sweden, and on the much less common disease, subacute sclerosing panencephalitis, in this country.

Drug Addiction

The prevalence of drug abuse in this country far exceeds the combined prevalence of all of the psychiatric and disease-induced disorders of behavior that have already been touched upon in this survey. According to the U.S. Bureau of Narcotics and Dangerous Drugs, there are some 9 million alcoholics in the United States. The incidence of abuse of amphetamines and barbiturates and the consumption of marijuana have increased enormously during the past ten years, especially among adolescents, but reliable quantitative estimates are unobtainable. At the present time there are probably in excess of 300,000 heroin addicts in this country.

Although minor individual differences in reactions to many drugs are common and the existence of rare major deviations from the normal metabolism of certain drugs has been known for a long time, it is unlikely that factors of this sort determine susceptibility to drug abuse in any important way. Instead, it seems clear that social and psychological forces are of overriding importance. From the preeminence of social and psychological factors in the genesis of drug abuse, it might be supposed that research on the medical treatment of narcotic addiction is altogether futile. Until recently, the recurrence rate of virtually 100 percent for many years among heroin and morphine addicts treated at the United States Public Health Service Addiction Research Center at Lexington, Kentucky, seemed to justify this skepticism quite fully. During the past five years, however, the experimental use of methadone in a maintenance program of treatment, rather than as a short-term agent to facilitate withdrawal from opiates, has shown rather impressive results. The recent study by Gearing of several thousand heroin addicts on the methadone maintenance program begun by Dole at Rockefeller University in 1964 showed that 60 percent of the subjects were "held" by the program. They had come away from a life of crime and were gainfully employed. Whether any substantial proportion will eventually also come away from methadone remains to be seen. Some have done so and perhaps more will, as their stake in a useful existence increases. There are now some 40,000 people enrolled in methadone maintenance programs in 14 major American cities and, as would be expected, illicit diversion of methadone exists in each of these cities.

It would appear desirable, therefore, that methadone maintenance programs be continued but with care to ensure that all of the features of control and close surveillance of patients, which have characterized the programs thus far, are maintained. It has already been demonstrated in this country and in England that superficial management of patients at understaffed and inadequately equipped centers is as likely to support narcotic addiction as to control it. Still, even if the philosophical objections to methadone maintenance are set aside, some purely pharmacological drawbacks remain—the potential toxicity of the drug, its short duration of action and its own addicting properties. Continued search is therefore in order for other opiate antagonists, the actions of which are more prolonged, and more exclusively receptor-site blocking in character. Clinical testing of several new compounds, including alpha-acetyl methodal, cyclazocine and nalox one, has already begun during the past two years with this end in view.

The extent and persistence of the abuse of alcohol, in spite of our present knowledge of the effects of alcoholism on the brain, peripheral nerves and liver, have prompted the rhetorically persuasive question, "Of what practical use is basic research on the pharmacology and toxicity of any addicting psychotropic drug?" It is almost as if the doom in the riddle-parable of the tree of knowledge had come to pass. But the answer is simple enough: the possession of knowledge, as everybody knows, does not guarantee rational behavior but ignorance makes it impossible. While the chemistry, metabolism and toxicity of alcohol, morphine, heroin, barbiturates and amphetamines are now quite well established, we know little of the specific cellular sites and mechanisms of action of any of these agents. In regard to marijuana, one of the most ancient and widelyused drugs, the legalization of which is now the subject of debate, the exact chemical structure of its active principle, one of the tetraphydrocannabinols, has been established only during the past few years by modern techniques of physical chemistry. Metabolic, pharmacological and psychological studies of any precision and value on marijuana have had to await this development and such studies have just been initiated during the past two years.

While it is true that many more people abuse drugs than are physically dependent on them, drug tolerance, physical dependence and withdrawal symptoms are often crucial in maintaining the state of drug addiction and in motivating criminal activity. This is especially so with morphine, heroin, alcohol and the barbiturates. Yet our understanding of the mechanisms of tolerance and dependence, and of the relationship between them, is rudimentary. Studies of the absorption, metabolism, distribution and excretion of drugs have shown some differences between normal and dependent human and animal subjects but, in general, these differences have been minor and insufficient to account for tolerance and dependence. It would appear that the mechanisms of these phenomena are related to events at target-tissue and cellular levels. Various hypothetical models of cellular adaptational processes have been proposed involving, for example, enzyme induction, denervation supersensitivity, multiplication of receptor sites and neurotransmitter blockade. In the present state of their development, however, these hypotheses are so general that experimental testing of them has been necessarily unsystematic and blunderbuss in character. Kalant, of the University of Toronto, has recently proposed methods of mathematical and kinetic analysis, resembling those that have been so useful in enzyme research, for the study of cellular tolerance and dependence which, together with modern techniques for the measurement of drug concentrations in small samples, may yield significant advances in the next few years.

Field Study of Animal Behavior

Until about 1960, with a few notable exceptions, the study of animal behavior in this country was conducted in the conventional tradition of laboratory research. Typically, all but a minimum of variables were excluded and only readily quantified formal behavior tests were used in a relatively limited number of species. While a vast body of important data was obtained in this way about learning as it exhibits itself when forced to proceed according to prevailing concepts of conditioning and reinforcement, a great range of behavior could never become evident under such restricted conditions. The average American experimental psychologist had little to say about the ontogeny of behavior, or about the influence of the social and physical environment on learning. Except as a by-product of some admirable studies of "latent learning", it is fair to say that spontaneous behavior was not systematically examined, probably mainly because so much of it was regarded as innate and, by this criterion, irrelevant so far as learning is concerned. It may also have been true that the convenience of learning curves for expressing results and the ease of obtaining them from operant conditioning experiments, exerted a subtle influence, the effect of which was to discourage other sorts of experimentation which might have been at least as likely to throw light on brain mechanisms in behavior.

In the 1960's a more diversified orientation began to appear in American behavior research. This salutary change may well have come about in some way simply because it was inherently due but it is more interesting and satisfying to think that several fascinating developments in human and animal biology, which occurred about that time, encouraged it and made it possible. In the 1950's Le Gros Clark began to report his detailed comparative studies of the South African Australopithecine fossils. The massive skepticism about the hominid character of this material, which had prevailed ever since the first skull was discovered in 1924 by Raymond Dart, had not yielded even to the beautiful monograph on the accumulated South African fossils published in 1948 by Robert Broom, the astute field-paleontologist, who was then in his 80th year. It was Le Gros Clark's analysis that succeeded in satisfying everyone that the Australopithecine fossils, despite their small brain-cases, represented the earliest known stage of hominid evolution. At the same time there appeared Weiner's definitive disclosure that the famous Piltdown fossil material, with its large brain-case and primitive jaws, was spurious. These coinciding developments, together with the considerable circumstantial evidence found in association with the Australopithecine fossils, established the present view that bipedal stance and gait, habitual tool-use and probably also the fabrication of tools and premeditated, cooperative hunting all evolved well in advance of any very marked change in size or general configuration of the brain beyond that of the ape.

It seems reasonable to believe that this contributed substantially to the impetus to resume the naturalistic observations on non-human primates that had been begun by Nissen and Carpenter in the 1930's only to be interrupted by World War II. In any case, the primate field studies that have been carried out since 1960 by Kortlandt, Kummer, DeVore, Washburn, Altmann, Goodall, Schaller and many others, have yielded data which, although still preliminary and rather general in character, are truly a plethora compared with what was available previously. We are now in possession of considerable knowledge of the habitat, natural behavior and social structure of a number of primate species, including especially the chimpanzee, baboon and the langur and rhesus monkeys, together with somewhat less extensive information on the gibbon, gorilla, orang and the prosimians. Several fallacies, previously widely accepted and used as support for certain items of behavior theory, and also as naturalistic premises for theories of human social and political behavior, have been dispelled by this recently obtained field data on primates. Thus the "harem" is by no means the universal, or even the most common type of social unit among primates. Continuous sexual receptivity and year-round reproductive activity are not at all characteristic of the primate species in which this information is available. It is thus not possible to attribute enduring social groups exclusively to sexual attraction. The amount and type of territorial behavior, hierarchical dominance relationships, group composition, mother-infant interrelations, and aggression are all quite variable from one species to another. Group composition, for example, ranges from the small, monogamous groups of the gibbon to the highly unstable groups of variable size in the open, promiscuous society of the chimpanzees. While it is true, so far as present observations go, that the general type of social behavior in a single species tends to remain basically the same in different locations, some striking instances of intra-specific variation have been observed depending on local variations in food supply, terrain and other features of the environment. It may well be that the potential for adaptive change is considerably greater than present observations suggest and, as one field student of primate behavior has remarked, there may be no such thing as a single "normal" social organization for a given species. Here is an obvious problem, the systematic investigation of which in non-human primates has just begun—the nature and the limits of behavioral variation in response to changing ecological conditions. This is a question of great theoretical importance to biology, and one which takes on a certain overwhelming urgency when it is remembered that the human primate species is now being forced by its own technology to face it on a massive scale.

What is already known about the diversity of social organization among non-human primates is enough to be a corrective for all naive and indiscriminate deductions from nature in support of one type of human political structure over another. If primate field studies have anything at all to say about such things, it is that there is no single political structure that is best suited for all human primates. If this conclusion from the facts of primate social life is disappointing in its sober overtones of irrelevance so far as political philosophy is concerned, these and other features of primate life in its natural setting have come to be recognized as highly relevant to learning theory and they have begun to influence profoundly its range and flexibility and the ways in which it is tested in the laboratory. Sexual and feeding behavior, adaptive responsiveness to signals of dominance and submission and to signals of danger from predators and, in the chimpanzee, nest-building and tool-use have all been found to have a developmental history in which there is a complicated interplay between innate behavior and learning. It has become clear that much of instinctive behavior is not so rigidly predetermined as was once thought (by almost everyone except L. T. Hobhouse and a few others, including Charles Darwin). On the contrary, instinctive behavior is altered and shaped by social and individual experience and, far from merely setting limits for learned behavior, it is imbedded in it as part of the final product of learning. Learning by imitation in animals, once regarded as extremely rare or impossible by those who looked for it in animals kept in laboratory cages, has been repeatedly seen in non-human primates in the field.

The observations of M. Kawai, the Japanese primatologist, on a group of Macaca fuscata living on the island of Koshima and on the radical changes in the life style of these monkeys, which were precipitated by his throwing sweet potatoes and later wheat on a beach which the animals had never before approached are a fascinating illustration of a reaction to new conditions and of some of the behavioral mechanisms involved. Among the elements that entered into this response, there were, first, inventions by one monkey, a young female, consisting of washing the sand from the potatoes by dipping, swirling and wiping them off in sea water and tossing handfuls of mixed wheat and sand into the water, waiting for the sand to sink, and then retrieving the floating wheat. These techniques were transferred, by imitation, first to those young monkeys who were closely affiliated with her for long periods of time and later, during the course of several years, to the entire population as a fixed tradition. Equally remarkable were the secondary effects of this novel use of the sea for separating food from sand: the sea became a source of seasoning for food already cleaned of sand and a place to play and cool off in hot weather and eventually several of the monkeys actually swam to a neighboring island.

Many of the observations that have been made in primate field studies have naturally drawn, for their interpretation, on the concepts of ethology, a school of behavior research which owes its central orientation ultimately to Darwin. Its inception more specifically as a particular kind of behavior research, having a primarily zoological rather than psychological methodology and outlook, is generally and properly attributed to C. O. Whitman and his student, Wallace Craig, in this country and to Oskar Heinroth, Konrad Lorenz and Niko Tinbergen in Europe. Ethological concepts, such as displacement activity and ritualization, innate exploratory ("appetitive") behavior, social facilitation and local enhancement and the inseparability of perception, instinctive behavior, learning and "insight"—concepts all stemming principally from naturalistic observations on birds and fish—encompass much of the feral behavior of primates also. In this way, something of a mutual enhancement between lower vertebrate ethology and primate field study has occurred during the past 10 to 15 years, the effect of which has spilled over as an extremely favorable influence on learning theory, augmenting its power and scope, and on laboratory behavior research, greatly increasing its diversity.

How much of this has any bearing on human behavior? It was pointed out some 40 years ago by Donald Keith Adams, one of those American psychologists who was exceptionally free of the rigid schools of thought of his time, that one of the principal factors tending to exaggerate the differences between the behavior and mental life of man and all the other vertebrates was the custom of psychologists to compare the learning ability of inexperienced, caged animals with that of adult humans. One of the primary contributions of ethology has been to emphasize those threads of behavioral continuity which extend throughout the vertebrates. Nowhere does this continuity become so startlingly evident as in the magnificent studies of the intellectual development of human infants and children by the Swiss psychologist, Piaget, whose work, permeated with a naturalistic style of observation and analysis, seems almost made to order as a corresponding opposite to Adams' studies in the 1930's on the remarkable capacity of experienced adult cats to deal with spatial and mechanical relations between objects.

There is still another side of the zoological approach to the study of animal behavior, which has only been alluded to tangentially thus far—the behavior research that is an indispensable part of ecology, concerned more with the behavior of populations than individuals, as one of the factors in the interaction between the biological and physical components of systems ranging in size from beetles and flour in laboratory jars, through small ponds, to entire continents. I cannot do more than point to this area, my familiarity with it being even less than with other subjects covered in this survey. Yet its ultimate significance may well rival if not dwarf that of all the others.

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Appendix XVII

Neurological Research as Viewed by the Practicing Neurologist

INTRODUCTION

As a practicing clinical neurologist in a community hospital, my point of view is that of the consumer of the results of research, and I am consequently acutely aware of the need of research which will lead to better diagnosis and treatment. Another equally important area of need is an improvement in the delivery of medical care including neurologic care.

Research for Diagnosis and Treatment

One of the areas of clinical neurology which has a great need of improvement is that of convulsive disorders. It has been many years since any significant improvement in medical therapy has appeared. The promising areas of research from a treatment point of view have been those dealing with the spread of epileptic activity and the development of secondary foci. These researches carry with them the promise of developing better surgical treatment. The use of conditioning in the treatment of seizures, although as yet of little value, also carries a promise of better treatment and a new type of management of seizure disorders. The research on the role of febrile seizures and the development of temporal lobe seizures has some very practical treatment implications and may be of great value in the prevention of seizure disorders. Studies on brain and nervous system cellular metabolism, although of no immediate value, also carry a promise of treatment application in convulsive disorders.

The problem of strokes appears to be insurmountable. Despite the establishment of acute stroke units and extensive studies on the physiology of cerebral blood vessels, the mortality and morbidity figures of stroke appear to be stable and will remain so until the problem of arteriosclerosis is solved.

The current trends in the study of slow viruses as a possible cause of multiple sclerosis would be exciting were it not for other breakthroughs in the past, all of which have promised much but delivered little for the patient with multiple sclerosis. Still, these trends will undoubtedly provide useful information which will have some treatment implications, even if not directly applicable to multiple sclerosis.

The treatment of brain tumor is beginning to show greater promise with the application of chemotherapeutic agents and radiation therapy. The studies currently underway will very likely lead to a brighter future for the brain tumor patient. The production of brain tumors in animals by the intracerebral injection of viruses suggests the intriguing possibility of immunological prevention of brain tumors.

The recognition of the entity of normal pressure hydrocephalus has reawakened an interest in intracranial pressure and C.S.F. metabolism which quite likely will be of value to all neurosurgical patients in the near future. The recent introduction of steroids in the management of increased intracranial pressure has already been of incalculable value to patients.

Headache is one of the most common neurologic complaints and one which cannot be satisfactorily treated with our present knowledge. The standard treatments of vascular and muscle contraction headaches have remained almost unchanged for 20 years. A continuing interest in the metabolism and body chemistry of these patients holds some hope for improving their lot. Although little research is continuing in this area, what is being done should be encouraged. Considering the nature of the world, this form of neurologic disability will continue to be a major problem in neurologic practice.

Muscle disease continues to be a glamorous area of research. From a statistical point of view this is not a major problem in neurology and as yet the research has not led to any significant treatment advances. Still some of the more recent work stressing immunologic, neuritic and vascular components of muscle disease promises a better understanding of the problem and may eventually lead to specific therapy. Methods for the recognition of carriers of muscle disease are being perfected. This area of research should be vigorously pursued and supported not only for the hereditary muscle diseases but also for all gene-transmitted disease.

The problem of treating ruptured and degenerative disc disease constitutes a major problem in neurology. The advances that have been made have been in the areas of patient selection and surgical treatment. Results are far from satisfactory in that there are many failures and recurrences. The most likely explanation is a lack of understanding of the etiology of the disease. This is an area which should receive the attention of researchers because of the magnitude of the problem.

The use of L-Dopa in parkinsonism has been a great advance. It is now apparent that this is a superior symptomatic treatment, but it does not really alter the basic pathologic processes operative in the disease. An understanding of these processes awaits further research.

The area of infection of the CNS appears to be the brightest area as far as treatment is concerned. The common bacterial infections as a rule are treated satisfactorily. There are, however, some more virulent bacterial infections such as pneumococcal meningitis which do not respond consistently to treatment, and the same is true to a greater extent of the mycotic infections, such as cryptococcal meningoencephalitis. Treatment of virus infections of the nervous system remains, of course, to be discovered.

Research in Medical Care Delivery

One aspect of the delivery of medical care which requires research is the development of practical screening techniques for specific diseases which can be applied easily to the population at risk. This is particularly applicable to the hereditary degenerative diseases. The techniques of amniocentesis for the lipidoses and muscle disease is one aspect of this problem which should receive major attention in future research efforts. Development of practical methods of applying known screening techniques is of equal importance. An example is that of ophthalmo-dynamometry which is of little value for the patient with a stroke but could be of value in identifying the potential stroke patient. Such screening methods should be practical for use in physician's offices and in community hospitals if this important aspect of preventative medicine is to reach the public.

Another aspect of this same problem which should receive attention in the near future is that of epidemologic studies of all neurologic disease. This information should be easily available to the family practitioner so that the risk patients can be readily identified.

The major problem in delivery of medical care is a shortage of manpower. This is true of all medicine as well as neurology. The development of labor saving devices such as computerization should have a prominent place in research in the near future. Certain areas are obviously ripe for this type of solution. EEG appears to be one area which could be almost totally computerized.

The use of nurses or other paramedical personnel certainly can free up physicians from hours of "busy work." The major problem here appears to be one of education of the physician to the advantages in the use of paramedical personnel and legal protection for the physician. Both of these problems should be easily overcome. This aspect of medical care delivery merits the immediate attention of all who have a responsibility for the health of the public. Until this is solved we will continue with our present system of emergency type medicine and the important goals of prevention of disease will never be achieved.

Conclusion

From the above remarks, it is apparent that I view the current management, treatment and diagnosis of most neurologic disease as unsatisfactory. Consequently, I believe that all neurologic research is important. In terms of priorities I hope that the common neurologic problems will receive the major attention.

I also view the current delivery of medical care as totally inadequate since the emphasis is basically on treatment and not prevention. I believe that this problem also deserves a high priority.

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Appendix XVIII

Research Task Force

Manpower Needs

The Research Task Force established an estimate of manpower requirements for neurological research in divisions and departments of clinical neurology in the United States during the five-year period, 1972–77, by means of a brief questionnaire sent to the heads of these divisions and departments in 102 medical schools in December, 1971. Ninety-nine replies were received. The salient information obtained was the following:

> Total number of present faculty—1,023
>
> Number of these engaged in both research and teaching—702 (69%)
>
> Number of additional faculty needed and proposed for recruitment during the next two years—227
>
> Total additional faculty positions, covering both research and teaching, considered essential during the subsequent three years (1974–77)—264
>
> Total number of faculty in 1976–77—1,514

The estimated total of 1,514 in the academic year, 1976–77, as compared to 1,023 in 1972, indicated that some 490 additional faculty positions in neurology will be created during the five-year period, 1972–77. One consideration that was overlooked is the anticipated attrition from retirement of faculty. A second questionnaire was therefore sent in June, 1972, asking how many faculty were within five years of the age at which retirement was expected, according to institutional policies. From this we learned that 73 men and women were in this category. Thus, it appears that to maintain neurological faculties at the level which heads of neurological divisions and departments believe necessary for teaching and research, 564 academic neurologists must be produced by our training programs during the five-year period, 1972–77.

Assuming that the proportion of newly-recruited faculty who will be engaged in research as well as teaching will remain at least as high as the present 69 percent, the total number of proposed faculty members in the academic year, 1976–77, who will be engaged in research is 1,045, as compared to 702 at the present time. In regard to this assumption, it is perhaps regrettable that we did not explicitly seek the views of neurological department heads on the proportion of their future, expanded faculties that would be expected to engage in research as well as teaching, and on what proportion engaged in this way would be desirable, or necessary. The wording of the third and fourth items of our questionnaire was ambiguous on this score.

Research and Neurological Education

All of the members of the Task Force were agreed on the desirability and importance of investigative work by faculty of clinical departments of neurology and it would appear, from the high proportion of present faculty who do research, that this view is, in fact, generally shared by heads of divisions and departments of neurology. The usefulness of research training in the education of clinical neurologists is a matter that involves a number of interacting philosophical and practical considerations. While it would be tedious, if not inappropriate, to set these forth and explore them exhaustively in this report, we came to believe that we could not ignore the question entirely, if only for the reason that some might consider it rather extravagant to maintain a large proportion of research-oriented personnel on neurological faculties at a time when the need for sheer clinical manpower in neurology so far outstrips the supply. A number of neurologists were queried regarding this subject. Their replies may be summarized as follows:

1.) The best training programs are those in which research as well as clinical work is conducted.
2.) Satisfactory training in clinical neurology is possible without research experience, but the trainee with exposure to research is a better clinician and more capable of coping with new developments in medicine.
3.) In the training of the neurological teacher-investigator, excellent clinical training is of the greatest importance but training and experience in research is also essential and the opportunity for research must be provided by any training program which expects to train neurologists for academic positions.

These replies indicate again that neurologists in general take it as self-evident that research work by academic neurologists and research experience for neurological trainees are highly desirable. In order to ensure that these views are not interpreted as merely circular pronouncements (training programs that conduct research are the best programs, hence research is essential to good programs), something of the basis for them deserves sketching in: Experience in research provides post-graduate trainees in neurology with first-hand familiarity with the literature, the techniques, and the possibilities and limitations of research. We believe that clinical practitioners of neurology who have had this kind of experience during their training will be far more likely to keep themselves informed about the progress of neurological research throughout their careers, to be receptive to the prompt application of the results of research in their care of patients, and to be capable of discriminating prudently between those research findings that are appropriate for clinical application and those that are not.

As for independent justification of research as a fitting activity for academic neurologists, it is to be noted that the development and maintenance of clinical faculties of neurology who are engaged in both basic and clinical research are what transformed neurology from a more or less exclusively nosologic discipline during the first half of the century to its present status as a dynamic medical specialty. Even Sir Francis Walshe, the distinguished British clinician, an inveterate skeptic about whether the nervous system of man can ever be explained completely in the mechanistic terms of physics and chemistry, had this to say when it came to research and its relation to clinical neurology:

> Clinical training, with a smattering of morbid anatomy, clinical pathology, empirical electroencephalography, electromyography and textbook psychiatry no longer is a truly scientific training for research into basic problems of nervous disease. Whoever contemplates such research must have at least one other string to his bow, and with this he must be prepared to train himself, as do young physicians in metabolic medicine today.[1]

From the broadest practical point of view we believe, as another eminent clinical neurologist once remarked, that "history and personal experience alike have convinced the enlightened physician that research in the natural sciences is the one indispensable hope for the solution of the countless unmanageable problems of human disease confronting him."[2]

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Appendix XIX

The Neurologist as Educator

INTRODUCTION

If there are to be physicians, there must be teachers to impart the knowledge on which the practice of medicine depends. Data on teachers of neurology were obtained from three sources: 1) published material dealing with relatively broad aspects of medical and neurological education; 2) results of a survey carried out by the Commission on existing manpower resources and anticipated manpower needs in neurology departments; and 3) the American Medical Association which provided data for 1971 on those physicians who classify themselves as neurologists, including those who state that their principal professional activity is "medical teaching."

General Aspects

Table 1 compares two periods, 1966–1967 with 1971–1972, as to the number of medical schools in the United States, the number of students in the schools and the number of graduates from them, and the total number of neurology residents as well as of all residents on duty September 1st in the two periods. Roughly comparable increases have taken place in the number of schools (21 percent), students (27 percent), graduates (23 percent) and in the number of all residents (33 percent). But the increase in the number of neurology residents in that five-year period (approximately 58 percent) is far greater than the increments in the other areas. There was also an increase during this time in the number of approved neurology residency programs, from 98 in 1966 to 111 in 1971, a 13 percent expansion, and this occurred while the number of approved residency programs in all specialties was declining from 4,849 in 1966 to 4,667 in 1971, about a 4 percent decrement.

Given this background, it is interesting to note the changes in budgeted faculty positions in medical schools for both neurology and all clinical departments during this period (Table 2). Here the reverse has occurred. While other clinical departments expanded by 57 percent neurology increased by only 24 percent. (Indeed, the observed increase in budgeted full-time neurology faculty appears to parallel more the increments in numbers of medical schools and students than the increase in neurology residency positions, despite the fact that, in general, training programs in neurology are the direct responsibility of academic neurologists.) This discrepancy may reflect a number of factors, the build-up of neurology departments prior to this five-year time frame or the influence of funded training programs upon residency choice or some other variable.

TABLE 1

Changes in Medical Schools, Medical Students, Graduates and Neurology Residents

	1966–7	1971–72	Percent Change 1966–67 to 1971–72
Number of American Medical Schools	89*	108**	+21.3
Medical Students	33,423	42,564	+27.3
Graduates of American Medical Schools	7,743	9,551	+23.3
Residents on Duty September 1st			
Neurology	541	854	+57.9
All	32,050	42,512	+32.6

* Includes five schools which graduated no students, three of which were two-year schools.

** Includes 14 schools which graduated no students, six of which were two-year schools.

Source: *JAMA*, Vol. 202, No. 8, 1967 and Vol. 222, No. 8, 1972.

Current Neurological Resources and Anticipated Needs in Medical Schools.

In 1971, the Task Force on Research of the Joint Commission sent out a questionnaire on neurology

TABLE 2

Changes in Budgeted Full-Time Faculty Positions in Neurology and All Clinical Science Departments in Medical Schools

	1966–1967	1971–1972	Percent Change 1966–67 to 1971–72
Budgeted Positions:			
Neurology	647	802	+24.0
All Clinical Departments	14,146	22,143	+56.5
Filled Budgeted Positions:			
Neurology	610	760	+24.6
All Clinical Departments	13,292	20,902	+57.3

Source: *JAMA*, Vol. 202, No. 8, 1967 and Vol. 222, No. 8, 1972.

manpower in medical schools to 98 neurology department chairmen and to the deans in those seven schools which did not have chairmen; 99 questionnaires were returned. The analysis by the Task Force yielded the following:

1.) 1,023 members (including neurologists and "neurological associates") of neurology departments are "regularly engaged in either basic or clinical science teaching in the broad field of Neurology."
2.) 702 of this group "are engaged in research activities, either as their sole activity or as a related part of their total academic program."
3.) In the light of present and anticipated needs for the next two years, 227 additional staff members are or will be needed; 38 (17 percent) of these positions were funded at the time the questionnaire was answered.
4.) An additional 264 positions in "both research and teaching should be available (five years from now) . . . beyond the numbers mentioned in questions 1, 2 and 3."

In summary, the anticipated manpower needs of medical school departments for 1977 total approximately 1,154 neuroscientists. Further, if the manpower needs of medical school departments expand at the same rate from 1977 to 1985 as they are expected to expand from 1971 to 1977, then a total of approximately 2,200 neuroscientists will be required by 1985, approximately double the numbers now available.

The Neurologist Educator

The A.M.A. characterizes physicians in its master file by their principal professional activity, patient care, medical teaching, research, administration and a residual category. The category of medical teaching included only 182 neurologists in 1971. It is clear that there is a large gap between the A.M.A. file number, the 760 budgeted, filled full-time neurology faculty positions shown in Table 2 and the 1,023 academic neurologists listed in the Task Force survey. If all neurologists who indicated their principal activity to be research and/or administration in a medical school or affiliated hospital were included, this gap is almost but not completely eliminated. However, the data given here refer only to those who list teaching as their principal professional activity.

First, in terms of age, the 182 neurology teachers in the A.M.A. data bank are less likely to fall into the younger categories or the older categories than their colleagues (Table 3). Thus, fewer than 9 percent are 55 or older, while 15 percent of all other trained neurologists are 55 or older. Similarly, while 18 percent of the neurologists are in the 25–34 category, only 12 percent of the teachers are under 35 years of age. On the one hand, young and inexperienced physicians are not likely to be placed in a teaching role. On the other hand, the expansion of neurology has been a recent phenomenon and recruitment of teachers has of necessity come from those entering the field since World War II.

About 60 percent (108) of the 182 neurology teachers are certified by the American Board of Psychiatry and Neurology; eight other neurology teachers are certified by other specialty boards and 66 (36 percent) had not been certified by any specialty board as of the date the A.M.A. file was copied for our use.

TABLE 3

Teachers of Neurology and All Other Trained Neurologists Distributed by Age, 1971

Age	All Other Trained Neurologists (percent)	Neurology Teachers (percent)
25–34	17.9	12.1
35–44	44.2	50.0
45–54	21.0	29.1
55–64	8.6	6.6
65+	8.3	2.2
N	2424*	182

* Excludes 792 residents and 182 neurology teachers.
Source: A.M.A. tape.

The fact that over one-third of those who describe their primary activity as teaching are not certified is worth noting. As the report on the "Training of the Academic Neurologist" points out, the teacher of neurology is expected to be an outstanding clinician as well as a good pedagogue and a competent researcher. Certification by a specialty board is generally held to be one of the major indicators that a physician is considered to be an outstanding clinician by his peers. It is also a criterion about which many medical schools and hospitals are concerned. Thus, the fact that a large percentage of those neurologists who describe their primary professional activity as teaching are not certified is an anomaly.

Because of these considerations, this group of 66 was studied in some detail. Twenty-four (36 percent) of the 66 are graduates of foreign medical schools. Among the 116 teachers who are board certified, only 12 percent are graduates of foreign schools. Nineteen of the 66 (29 percent) are 34 years of age or younger, while among those who are certified only 3 percent are under 35. Also, 15 percent of the non-certified teachers are women, compared with only 3 percent of those who are certified. At least four teach in non-medical school university settings, three are in the V.A. or the Air Force, five are hospital based but not in university affiliated hospitals and two may be misclassified because of errors in the data processing.

In terms of their educational background, about 21 percent (38) of the neurology teachers were graduated from foreign or Canadian medical schools. Among those who are graduates of American medical schools (144), almost half (68) came from 13 schools (Table 4). If we look at a somewhat different question, which schools produce neurologists who are most likely to enter teaching, a somewhat different pattern emerges. The nine schools providing the largest percentages of teachers from their neurology graduates are listed in Table 5. Three schools in particular (Tulane, Minnesota and Medical College of Wisconsin) seemed to produce relatively high proportions of academic neurologists: four of Tulane's 19 neurology graduates are teaching neurology, as are eight of Minnesota's 59 neurology graduates and four of the 29 neurology graduates of the Medical College of Wisconsin.

American neurology graduates were divided into those coming from privately owned and those coming from publicly owned schools. Among neurology teachers, 65 percent were graduates of privately owned schools.

Where are the neurology teachers now? Three-fourths of them (138) are in the largest cities and almost 70 percent are based in medical schools (Table 6). (Of the 29 neurology teachers in non-federal hospitals, at least 16 are in university or affiliated hospitals, raising the proportion who are essentially medical school based to 77 percent.) The 1971 location of all other trained neurologists in SMSA's parallels, though in less extreme fashion,

TABLE 4

Schools which were Sources of Four or More Neurologists Reporting Teaching as Their Primary Activity

Schools	Number of Neurology Teachers	Percent of American Graduate Neurology Teachers
Columbia	8	5.6
U. Minnesota	8	5.6
Harvard	7	4.9
U. Chicago	6	4.2
Indiana	5	3.5
Pennsylvania	5	3.5
Jefferson	5	3.5
Yale	4	2.8
Iowa	4	2.8
Tulane	4	2.8
Cornell	4	2.8
Case Western Reserve	4	2.8
Med. College Wisconsin	4	2.8
Total, 13 Schools	68	47.6
Total, All American Schools	144	100.0
Total, All Schools	182	

Source: A.M.A. tape.

TABLE 5

The Nine Schools Showing the Highest Proportion of Neurology Graduates in Teaching

School	Percent of School's Neurology Graduates in Teaching	Total Number of Neurology Graduates
Tulane	21.1	19
Med. College of Wisconsin	13.8	29
U. Minnesota	13.6	59
Columbia	9.8	82
U. Chicago	9.7	62
Indiana	9.6	52
Yale	9.5	42
Case Western Reserve	9.3	43
Iowa	8.9	45

Source: A.M.A. tape.

TABLE 6

Neurology Teachers Distributed in SMSA's by Practice Setting, 1971

Population of Aggregated SMSA's *	Medical Schools	Non-Federal Hospitals	V.A.	Other**	Total (percent)
+ 1 million	89	27	12	10	75.8
500,000–1 million	19	2	2	—	12.6
Less than 500,000	17	—	3	1	11.5
Total	125	29	17	11	182
Percent	68.7	15.9	9.3	6.0	100.0

* Standard Metropolitan Statistical Area.

** Includes private practitioners and those based in federal facilities other than V.A.

Source: A.M.A. tape.

TABLE 7

Percentage Distribution of Neurology Teachers, All Other Trained Neurologists, Medical Students and Neurology Residents in 12 States, 1971

State	Neurology Teachers	Other Trained Neurologists	Medical Students	Neurology Residents
New York	18.1	15.5	11.7	17.7
California	8.8	14.3	6.9	8.7
Minnesota	7.7	4.2	1.9	5.4
Massachusetts	6.6	5.4	3.7	9.5
Ohio	4.9	2.8	4.0	4.4
Texas	4.4	3.9	4.6	2.9
Michigan	3.8	2.4	3.9	3.4
Pennsylvania	3.3	5.4	8.1	5.8
Maryland	3.3	5.0	2.3	3.7
Washington	3.3	1.7	1.0	1.4
Missouri	2.7	2.1	3.2	3.4
Illinois	2.2	3.5	6.4	3.5
Total, 12 States	69.1	66.2	57.7	69.8
Total Number	182	2,379*	43,605	791*

* Excludes 46 neurologists for whom no address is known, one a resident.

Source: A.M.A. tape; *JAMA*, Vol. 222, No. 8.

that of the educators: about 63 percent are in areas with populations of more than one million, 13 percent are in areas of 500,000 to one million population and the balance (24 percent) are in the smaller metropolitan and non-metropolitan areas.

The distribution of neurology teachers by state is, predictably enough, related to the distribution of medical students and/or neurology residents by state (Table 7). The degree of concentration of neurology teachers in the 12 states listed seems to be more strongly related to the distribution of neurology residents than to that of medical students. (A rank order correlation of the distribution of teachers and residents yielded a value of +.62, significant at p = .05; the rank order correlation between teachers and medical students yielded a value of +.27, which was not significant.) This relationship between location of teachers of neurology and location of neurology residents is not unexpected if we recall that the volume of neurology taught by neurologists in medical schools may be relatively small while neurology residents must be trained by neurologists.

Appendix XX

Undergraduate Medical Education in Neurological Sciences

INTRODUCTION

There are serious threats to proper and balanced teaching and training programs in the neurological sciences in medical schools. This brief presentation will set forth the problems as they relate to undergraduate medical school teaching and consider alternatives which, if adopted, could make for a more secure future. It is appropriate that these matters be considered at this time because major shifts in curricula, financing and educational policies are under consideration in many medical schools. The perspective of this subcommittee report includes the views of medical school administrators and of active members of the faculty teaching neurology to medical students. For purposes of presentation the report addresses itself to the rationale for undergraduate preparation, the curriculum objectives prevailing in most medical schools, the problem of sustaining relevant academic departments, the interrelationships of those departments teaching neurological sciences and lastly the potential impact on the capacity of medical schools to continue this effort should funding be markedly reduced.

Rationale for Undergraduate Preparation

The importance of undergraduate exposure to neurological science rests in part at least with the opportunity provided for attracting young physicians to neurology as a professional career.[1] Surveys suggest that this selection occurs more frequently in those schools which provide both basic and clinical components of the neurology curriculum. The desirability of the effort to attract new recruits to clinical neurology is related to the unfilled manpower needs required for the prevention and treatment of neurological illnesses. We believe such shortages presently exist and will be documented by our Task Force on Neurological Services.

An additional factor to consider is that diagnosis of neurological disability is quite difficult in some instances and may require the skills of a specialist. The exposure to neurology that most students receive in medical schools at present probably does little to prepare them to recognize a neurological condition. It does not equip them to diagnose and treat the neurological patient. In any circumstance the general physician needs some acquaintance with neurology. Because of the high incidence of neurological disease and the known shortage of specialized manpower, the bulk of care currently given victims of neurological disorders on a countrywide basis will almost certainly be rendered by physicians who have not had the advantage of graduate medical education in neurology or neurosurgery. In fact, for many general physicians, their undergraduate experience will be the only opportunity they have to become familiar with neurological problems and the handling of them in an expert manner.

Some background in neurology for all medical students is valued for a fuller understanding of the whole person who is the patient and for swifter and possibly life-preserving recognition of those instances where instant referral to the specialist is required.

This is important because, as the report of the Task Force on Neurological Services of the Joint Commission on Neurology has shown, neurological and sensory disabilities are a major cause of chronic human suffering and economic burdens in the United States.

Medical School Objectives

In the mid 1960's, most United States medical schools responded to strong pressures for change in the traditional (post-Flexnerian) medical school curricula which had required students to spend almost all of the first two academic years in the basic sciences and the final two years in clinical sciences. As a result of these changes, virtually all medical schools have reduced time requirements in the traditional basic and clinical sciences and now have either one or two elective years with few constraints on elective course distribution. The period devoted to the basic neurological sciences, including neuroanatomy, neurophysiology, biochemical and pharmacological aspects of the nervous system and neuropathology, has been reduced significantly. This has fostered anxiety among both neurobiologists and clinicians concerning the extent and quality of exposure which today's medical students have to neurological material. In addition to the changes noted, most departments of neurology and neurosurgery are faced with the reality that medical students are no longer *required* to take clerkships in their disciplines. Electives have replaced the traditional clerkships. The foregoing statements describe many if not the majority of medical schools. The question before the neurological community is, what can be done to utilize the good aspects of curricular changes without destroying the important methodologies for introducing students to the nervous system.

Internships as such are expected to be eliminated by 1975. The maturation and general exposure they afforded to budding neurologists and neurosurgeons will be lost. Entering trainees will be less well prepared than their predecessors. It is apparent that the time in the medical school curriculum for neurological sciences becomes even more important than formerly. What steps should be considered to compensate for these changes and assure adequate preparation for these specialties?

In most schools, "neurobiology" has replaced the separate courses in neuroanatomy, neurophysiology and other basic neurological sciences. The reason is the recognition of the interdependence of the neurological sciences in introducing students to the nervous system. However, it is quite difficult to mount a truly effective neurobiology course. All too often, neuroanatomy, neurophysiology and neuropathology are simply set in temporal juxtaposition. Such courses resemble a picaresque novel in which the student is given a series of episodes rather than a truly integrated course taught in an interdisciplinary way by a group of faculty, each aware of what the other is doing in the presentation of subjects covered by more than one discipline. To avoid this, adequate planning by the faculty and follow-up monitoring or evaluation are needed.

There are many complaints of insufficient time by neurobiological faculties. Despite this, most courses could profit by elimination of inappropriate or duplicatory lecture material. Faculties need to make greater efforts to prepare and make available to students audiovisual presentations of the fundamentals to be covered. Much of what is presented to first year students by way of neuroanatomical and neurophysiological concepts could be presented with slides and audio tapes (and in the near future with video tapes), so that students could cover the fundamentals in the library and then have them reviewed during conferences (with additional details added). The tapes could also be reviewed after lectures. Such introductory presentations could be made either by a knowledgeable faculty member or by someone drawn from another institution. If department chairmen recognize the need and are appreciative of these supplemental but essential teaching efforts, the motivation to participate should be ample.

Small group teaching utilizing junior preclinical faculty, clinical faculty and house staff would greatly enhance the effectiveness of the use of advanced educational technology. It is our opinion that many schools have not taken sufficient advantage of these possibilities.

It is our opinion that with effective utilization of time on clinical services, many students will wish to take additional electives. About 25 percent of students become so interested in the nervous system that they realize they have been given only a useful and exciting taste of the basic and clinical problems, many of which remain unsolved. One concept worthy of consideration is the "track system" for students who have decided while in medical school that they wish to enter postgraduate training in neurology. Training program directors may recommend appropriate electives which will provide such students with a sound understanding of medicine, pediatrics and psychiatry. Additionally, the trainee who has omitted an internship will be able to compensate better for the deficit because of a more organized undergraduate preparation for our discipline.

One example of how this may be accomplished is the following proposed model neurology track:

MODEL NEUROLOGY TRACK

FIRST ACADEMIC YEAR

First Semester

- Anatomy
- Physiology
- Pathology
- Introduction to Medicine

Second Semester

- Biochemistry
- Cell Biology
- Neurobiology

Introduction to Medicine
Medical Genetics

May and June (6 weeks)
Pharmacology
Radiology

SECOND ACADEMIC YEAR

First & Second Semesters
Neurology (4 weeks)
Psychiatry (4 weeks)
Medicine (8 weeks)
Neurobiology Electives (8 weeks)
Obstetrics and Gynecology (4 weeks)
Pediatrics (4 weeks)

THIRD ACADEMIC YEAR

First & Second Semesters
Medicine Electives (8 weeks)
Pediatric Electives (8 weeks)
Neurosurgery or Anesthesiology or Orthopedics Electives (4 weeks)
Surgery (4 weeks)
Clinical-Basic Science Electives (8 weeks)

FOURTH ACADEMIC AND CALENDAR YEAR
In-Patient Neurology (6 months)
Junior Internship in Medicine (6 months)

Academic Department Program Support

The critical problem in medical neurology is one of numbers needed for the future. Advisors to the Institute (NINDB and later NINDS) agree that 60 centers of training excellence in medical neurology are the minimum required to assume responsibility for the training of the teacher-investigators required to fulfill the base needs of approximately 120 medical schools plus 100 teaching hospitals.[2]

In order "to begin to meet the Nation's needs for training programs for medical neurologists," the NINDS estimates that it requires in fiscal year 1976 60 graduate training grants providing long-term support for centers of teaching excellence and up to 25 developmental level graduate training grants to give short-term support (e.g. 6–8 years) to evolving training environments.[2] Thereafter, these latter will either join the present pool of approximately 30 centers of excellence or become the superior additional programs needed for the training of medical neurologists to meet community clinical needs. In summary, the fiscal 1970 total of 62 graduate training grants will have to be raised to 85 sometime before 1985 to provide even a 25 percent increase in the number of trained neurologists available then.

Training centers for educating both the clinical academician and the superior clinician have evolved at the same centers, whether in medical schools, graduate schools, hospitals or clinics.[2] This is because training aimed at preparation for diagnosis and treatment of neurological and communicative disorders requires high specializaton of teacher, facilities and equipment, all of which are also required for training programs aimed at the preparation of personnel for careers in teaching and clinical research.[2]

The significant shortage of teacher-investigators dictated that, when training programs were first established, high priority be given to increasing the number of academicians so that the necessary number and quality of training units could be made available for all purposes.[2] The Institute has generally provided stipend support only to those persons preparing for careers as academicians. The Institute has always insisted that the training institution share with it responsibility for the support of trainees. With the exception of the pilot cerebrovascular clinical training program, only those trainees who were designated as preparing for careers in academic medicine received direct support through training grants, fellowships or special traineeship funds.

Recently the National Institutes of Health examined extensively the economics of academic department program support. This was incorporated into the conclusions of the 1970 report on *NIH Training Programs Now and in the Next Decade*. Excerpts from the final paragraphs of that report are relevant here:

> "In exercising its broad responsibilities for education and training to meet national health needs, the NIH, through its Bureau of Health Professions Education and Manpower Training,* provides the major federal support for health-manpower education and support of its institutions. It is clear that meeting national needs will require immediate full funding to the authorized level of existing programs. A number of requirements beyond those authorized by present programs have also been identified.
>
> Through the NIH institute training program, the NIH supports the training of faculty for teaching and research in order to staff medical schools and universities, and also to train clinical scientists and physicians for both teaching and the complex task of modern medical care. . . .
>
> Both of these endeavors, the support of basic health manpower education and the NIH institute training program, are absolutely essential and are interdependent.
>
> Without an increase in both the number and output of medical schools, the already criti-

> cal supply of physicians will worsen. Without faculty to staff them the schools cannot be established, grow or function.
>
> Without further advances in medical and scientific knowledge, our hopes for major advances toward the future conquest of disease will be bitterly frustrated."[3]

A marked change has occurred in training program support in the last two years. The executive branch of the government indicated during the 1968–72 period that funds available for training would be reduced. This was accomplished by holding the funds level or in some instances reducing them, while inflation further decreased the number of dollars available. As a result of this, training programs which would have been funded in the 1950–68 period were no longer able to be funded. With the announcement of the President's budget on 29 January 1973 and a subsequent memorandum from the acting director of NIH, it was made explicit that there would be a phase-out of all NIH research training programs. This will occur over a three year period, beginning in 1973. The enormous impact of this policy decision on many institutions has been described in numerous articles and memoranda. These include reviews of the President's budget in Science,[4] the Chronicle of Higher Education, bulletins from *The Association of American Medical Colleges* and other sources.

During the last 20 years, dramatic changes have occurred in the neurological sciences faculties in medical schools, both in their internal structure and their fiscal support. There has been a virtually complete separation of neuropsychiatry into its discipline components. Fifty-eight percent of neurology units are now departments with permanently appointed heads. Numerous sections, divisions or departments have been established in neurosurgery as well. There has also been a substantial expansion through the addition of specialists in programs of neuroanatomy, neurophysiology, neuropathology and neurochemistry. The funding levels of these departments, divisions, sections or programs have become heavily dependent upon federally sponsored research and/or training programs. The addition of neuropathologists, etc., was often accomplished by the availability of new funds. Instead of a generalist of the basic science departments teaching neurochemistry, neurophysiology, etc., along with the broader field of neurobiology, there has been increasing involvement of research specialists in teaching undergraduate medical students.

In the clinical sciences the separation of neuropsychiatry into two departments (the most common pattern) was achieved for both through the addition of substantial sums for training as well as clinical research. (More medical school space was also occupied.) It is not unusual to find departments which receive as much as 70 percent of their support from extramural sources. Such high levels of dependence are more typical of neurology than neurosurgery.

It must be borne in mind that a critical interrelationship exists between all the components of teaching in the neurological sciences. The strength of the whole enterprise is dependent upon the strength of its component parts. Thus, if neuropathology withers in an institution, it has ramifications for neurological surgery, neurology, etc., despite the compartmentalization of funding sources to fiscally independent units.

General appreciation is needed of the full breadth of the programs in question and their relevance to the proper preparation of the medical student. Such understanding is imperative at the levels of the medical school administration and federal agencies dealing with the "unrestricted" educational monies currently awarded.

Summary

1. The rationale for the significance of neurological science teaching in undergraduate medical education programs has been presented. Emphasized in this regard is the prevalence of neurological disease and the shortage of neurological specialists.

2. Curriculum characteristics which are becoming the norm are described and discussed. The "relevance" of the shortened curriculum to integrated neurobiological teaching and various techniques to enhance its value are presented.

3. The economics of academic departments or programs has been discussed with some emphasis on their vulnerability. The significance of federal funding levels has always been very great and with the recent changes outlined in the President's budget of January, 1973 and the steps taken to implement this, it is obvious that an enormous change has come into the lives of our institutions and academic departments. Some of these institutions and departments may not survive under the new "rules of the game." Others will survive but will have to make major changes in their methods of support. Some of these new methods will involve more contract work, a much greater emphasis on service and fees generated from service and an unusual emphasis on grants for categorical areas of study such as cerebrovascular disease, mul-

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*Now Bureau of Health Manpower Education.

tiple sclerosis, studies of violence and aggression, behavior disorders and others which could be listed. Our deep concern is that the shift in emphasis and measures adopted to insure financial survival should not constitute too great an emphasis on expediency and further extend the anti-intellectual trends of the past few years. A corollary concern is that the historic mission of a university department may be distorted and that fiscal viability will be emphasized to such a degree that today's research will never be done and tommorrow's health care will be unrealized because of a static, uncreative environment.

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Appendix XXI

Specialty Training in Neurology

INTRODUCTION

An ideal training, which culminates in certification to practice a medical specialty, may be likened to the architectural plan of a skyscraper conceived and built in conformance with an overall vertical design. The training to become a specialist in any branch of medicine starts upon entry to medical school and proceeds along a well-defined channel from undergraduate through graduate education. After an interlude in practice the physician may submit to examination by the certifying board of the chosen specialty and, if successful, become a qualified practitioner of that discipline.

The specialty of neurology is unique in encompassing the functioning of the most complex organ system of the body, composed of the brain, spinal cord and the peripheral nerves. The diseases which affect the nervous system are the usual ones of trauma, neoplasm, inflammation, parenchymatous degeneration and occlusion of blood supply. These diseases may be primary (confined to the nervous system) but in some instances occur secondarily to more widespread bodily disease. Thus, to function skillfully a neurologist must not only have a good knowledge of the anatomy, physiology and pathology of the nervous system but also about general medical and surgical conditions and the ability to evaluate emotional factors which may contribute to the illness. Above all, from symptoms and signs encountered during neurological history-taking and examination, the neurologist must be able to distinguish generalized from localized involvement and, where the latter is the case, to specify with accuracy the site of the lesion.

History of Neurological Practice

The specialty of neurology developed in Europe during the latter half of the 19th century, the neurologists themselves playing an important role in developing the basic science specialties which came to underlie their work. Americans trained in several European countries, notably England, France, Germany and Austria, began to set up practices in the United States toward the century's end. At first the practice of neurology was associated with that of psychiatry under the then popular term *nervous and mental disease*. On the mental side the neurologist then functioned largely as an alienist who after an examination certified concerning the sanity of the patient. In the beginning, neurological practice was largely based on pathoanatomical knowledge and the goal of practice was to establish the site and nature of the disease process.

In the early 20th century opportunities to receive neurological training in the U.S. were still scarce. Proficient teachers were few and scattered and diagnostic acumen continued to be largely acquired from European training. However, prior to World War II more opportunities for good graduate training became available in our country and in 1934 the American Board of Psychiatry and Neurology was founded for the purpose of setting training standards and conducting certifying examinations in these specialties.

Radiological and neurosurgical developments led to the adjunctive diagnostic methods of pneumoencephalography, ventriculography, myelography and angiography. In the 1930's electroencephalography, established as a science by Hans Berger, also reached the stage of clinical utility in the diagnosis of epilepsy. Electromyography followed with its applications in the evaluation of nerve lesions and neuromuscular disorders.

Even at this stage of neurological development many referring physicians continued to have a negative attitude toward neurology, holding that little besides diagnosis could be offered the patient.

Commencing in the thirties a number of important breakthroughs in therapy developed. One was the development of diphenylhydantoin for the treatment of grand mal epilepsy and later of trimethadione for petit mal epilepsy. Neostigmine was discovered to be effective in myasthenia gravis. Penicillin led to the near disappearance of the manifestations of syphilis and sulfa drugs to the treatment of meningitis, inflammation of the covering membranes of brain and spinal cord.

World War II made evident the considerable dearth of neurologists and the paucity of training programs then available to provide them in sufficient numbers to fill the teaching, research and practice needs of the post-war era. During the fifties an event of historical importance to neurological development occurred. The National Institute of Neurological Diseases and Blindness (later renamed the National Institute of Neurological Diseases and Stroke) was developed under the auspices of the National Institutes of Health. The institute has provided large scale support for research and training in the neurological field and has stimulated the production of many high grade scientists, academicians and practitioners in the span of the 1960's. At present, data from a survey carried out by the Joint Commission indicate that there are 1,023 neurologists holding academic positions in the medical schools of our country. (An additional 227 budgeted positions are now available or will become so during this year.) Fifty-eight percent of medical schools now have neurology departments with permanent chairmen. Among individuals now holding medical school appointments, 69 percent are engaged in research in addition to their teaching and clinical duties. Projecting our data to 1976–77 the total of faculty appointments then should reach 1,514.

The Current Graduate Training Program

Interpreted broadly, neurology is concerned with the totality of scientific knowledge of the nervous system. Used in a strictly medical sense the derivative word *neurologist* denotes a physician skilled in the diagnosis and treatment of diseases of the human nervous system. In addition to medical school training and an internship (or its equivalent), specialization in neurology ordinarily requires three or more years of advanced training at the end of which the candidate's competence to practice the specialty is recognized when he successfully passes a comprehensive proficiency examination. These requirements are not inflexible and alternatives are available to specially gifted students or to those who have had an exceptional prior education.

The A.M.A. Directory of Approved Internships and Residencies (1969–70) lists 88 neurology programs in the United States. Of these, 86 were approved for three years of training by the Council on Medical Education and the American Board of Psychiatry and Neurology operating through the Residency Review Committee for Psychiatry and Neurology. Only two of the 88 programs were approved for two years. The following is a quotation from *Information for Applicants*, published by the American Board of Psychiatry and Neurology, Inc.

> "The training for neurologists should be based on clinical work with adults and children with neurological disorders, including the neurological complications of medical and surgical conditions. This should be combined with study of the basic neurological sciences, neuroanatomy, neurophysiology, neuropathology, neurochemistry, neuropharmacology and neuroroentgenology. This training should be supervised and guided by teachers competent to develop skill and understanding in the utilization of such basic knowledge in dealing with patients. Mere factual knowledge is not sufficient. This training should include sufficient training in psychiatry to enable the candidate to recognize and evaluate the common psychiatric reactions."

Neurological training involves both the acquisition of a large body of knowledge relating to many disease conditions and supervised experience in diagnosis and therapeutics. It is impossible to accomplish this mission in any brief period or as a part of a more extensive program. Until recently the M.D. degree followed by a one-year internship was considered the minimum requirement for entering training. It now appears that the internship will be eliminated and that phase of physician training incorporated into the residency program. Past observation has suggested three years as an irreducible minimum and four years as optimum. However, this is not inflexible and alternatives can be sought by specially gifted students or those who have had exceptional past educational advantages.

For the reader unfamiliar with the usual content of the residency training program we list items included. However, programs differ measurably in their detail and in the distribution of time devoted to the different components. We are more concerned here with emphasizing the intensive character of the training that is necessary and would avoid the implication that all programs follow the same course. In fact, viewed nationally, variability is their outstanding feature.

As a part of the undergraduate medical school curriculum students acquire an elementary knowledge of the anatomy, physiology, chemistry, pharmacology and pathology of the nervous system and are also grounded in cardiovascular and respiratory physiology. In the clinical years they are introduced to inflammatory, neoplastic, vascular, traumatic and degenerative diseases to which the nervous system is heir. They learn to conduct the basic neurological examination and to recognize when special diagnostic examinations conducted by laboratory, radiological, ophthalmological and electronic methods are indicated.

The internships, shortly to be absorbed as a part of specialty training, provided the trainee with the basic skills contributory to the care of the patient and with an understanding of medicine's standards of competence, including those of ethics, knowledge, judgment and sensitivity to human misery. The intern gets the first real indoctrination into the physician responsibilities inherent in the doctor-patient relationship.

The Joint Commission on Neurology Task Force on Education is concerned about the free-standing internship. Can we be sure that a medical student will become proficient in patient care if he is allowed to select the electives which make up his senior year prelude to residency training? When he begins the period of residency training the demands have become too specific to provide a broadly based training for medical practice such as is now obtained during an internship. In short, it appears highly undesirable for medical students to enter neurology without a transition year in which exposure to diagnosis and treatment is provided and it is recommended that neurology training programs develop new means of providing patient care experience, possibly by extending the residency to four years or by placing the entrant in a patient care setting—family practice, internal medicine or pediatrics—with some sort of "preceptor arrangement" before he embarks upon neurology training. It may be too early to specify what the precise nature of such patient care exposure should be but that it is a necessity is unquestionable.

Two full years of a neurology residency program should be devoted to bedside and outpatient care, including both the intensive treatment of the patient hospitalized for emergencies such as coma of all sorts, stroke, brain tumor and myasthenia gravis, and the continuing care of the recently paralyzed patient. In the emergency care of the unconscious patient the resident must become experienced in life support measures such as maintenance of an adequate airway and pulmonary ventilation and know the indications for inserting an endotracheal tube or performing a tracheostomy. His knowledge should also include the regulation of blood pressure during the acute phase of a stroke or other vascular illness and recognition of the need for a consultation where indicated. He observes the techniques for taking skull and cervical spine x-rays in bed-ridden stroke patients. For myasthenia gravis he needs to recognize immediately that an emergency exists and to be able to appraise the effects of anti-myasthenic drugs that may have been given previously. He should also know the substitutes available in the event of an inadequate response to the commonly used ones.

The trainee acquires the necessary skills in treatment of the recently paralyzed as a co-partner in the team with medical students, nurses and attendants. There he learns the proper positioning of such patients and the care of bladder and bowels. He learns to coax the return to mobility of the paralyzed parts and speech when it, too, is lost. These are necessary preludes to the rehabilitation procedures to follow. He should also become familiar with the rehabilitative measures usable in the home and able to instruct nursing personnel in such care. Even where physical therapists are available their limited time with the patient must be augmented by others, including nurse and family.

In addition to his participation in emergency care, the training of the resident includes the work-up of a variety of day-to-day diagnostic admissions to the service. During this experience he comes to assume prime responsibility for the hospital care and out patient follow-up of selected patients. The latter is similar in many respects to return office visits to a practicing specialist. On the wards of a children's hospital the trainee learns the details of emergency care of the child—epileptic status, evolution of head trauma and the serious neurological conditions which either may not occur in adults or differ significantly in their handling.

In the course of this training he must learn to elicit a detailed neurological history and to perform a skillful examination designed to differentiate between the symptoms and signs of the different neurological disease entities. He should know the indications for and how to perform a lumbar puncture and to examine the cerebrospinal fluid, including the registration of pressures. He acquires knowledge of and how to perform and evaluate routine and special x-ray procedures such as skull, spine and chest examinations, pneumoencephalography, myelography, angiography and brain scan. For his x-ray dependent training the resident may be assigned for three months of his two years of steady clinical work to a competent neuroradiologist, working full-time. He also learns how to record and interpret electroencephalograms, echoencephalograms and electrocardiograms.

During training, residents contribute to weekly seminars based on readings from numerous journals and books. These are systematized for presentation to other residents who discuss the reading surveys with respect to cases currently under study. Staff members often attend to advance their own understanding of recent therapies such as the use of anticoagulants in threatened strokes, L-Dopa for Parkinson's disease, cholinergic drugs in myasthenia gravis and antibiotics in infections.

In the remaining year, wherever placed in the graduate training curriculum, the resident undertakes adequate basic training in the scientific fields which underlie clinical neurology. In addition, advanced training may be undertaken in clinical subspecialties such as neuro-otology, neuro-ophthalmology, advanced pediatric neurology and rehabilitation.

Neuropathology is the key science area that must be mastered thoroughly. The resident works with the neuropathologist in the performance of autopsies upon patients who have died of a neurological condition. Besides its direct value, this provides an opportunity for inspecting the contents of the skull and spine to refresh one's knowledge of anatomy. Such exposure contributes to visual imagery of both normal anatomical relations and their disturbance by the disease process leading to death. Here the resident has his opportunity to study step-sections of brain and spinal cord and to trace the blood vasculature supplying strategic brain areas. Sections of the same brain are examined by light microscopy as well. During that study he may recall the clinical features of the disease in a particular patient as he sees its pathological details unfold under the watchful eye of the pathologist.

The other basic sciences which must become known in detail, and the knowledge retained as a part of the store carried into every sickroom, are neuroanatomy, neurophysiology, neurochemistry and neuropharmacology. As taught by the neuropathologists, neuroanatomy is largely the display of the detailed relations of brain parts. However, there is another aspect which is very closely linked with the functions of the brain. The neurological examination of the patient gives expression to the search for motor or sensory deficits due to malfunction in the intercommunicating tracts and centers which make up the brain and spinal cord. Using such information the clinician is able to localize a disease process which attacks one or another part of the nervous system.

Clinical neurophysiology has many ties with neuroanatomy and is taught most effectively as the neurologist demonstrates the combinations of motor and sensory losses a patient presents, the genesis and characteristics of involuntary movement, gait disturbance and ocular, facial, cranial and extremity motility. This is supplemented by lectures and demonstrations drawn from classical experiments upon reflexology.

Neurochemistry and neuropharmacology provide knowledge of the energy metabolism of the brain, of the principal hormones and transmitter agents which operate at a cellular level in nervous functioning and of the action of drugs used in a variety of neurological conditions, together with their indications, contraindications and toxic reactions.

Additional training, education and experience are required of those who would enter academic medicine to teach and to conduct or direct research.

Summary

This section discusses the postdoctorate training of physicians who specialize in the diagnosis and treatment of diseases of the nervous system. It is primarily directed toward health administrators and other professionals concerned with health care delivery. The evolution of neurology as a medical specialty is reviewed briefly leading to consideration of its status as a health science. Thereafter the content of the neurology postgraduate training program is surveyed to provide an understanding of the scope and depth of medical competence possessed by the neurological specialist.

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Appendix XXII

Continuing Education in Neurology

INTRODUCTION

In medical education, the term "continuing education" defines the task of keeping physicians acquainted with the appropriate body of medical information as it accumulates in their entire professional lifetime following their formal training. It is a truism that this task has become a massive one in recent decades because of the information explosion. A few decades ago the problem was whether neurology was an "independent" specialty or a "sub-specialty" of medicine or psychiatry; the question now rather tends to be whether, or less simplistically to what degree, fields such as electroencephalography, electromyography, neuroradiology, neuro-otology are autonomous. In all these areas and others there is a proliferating body of information reported on by one or more journals.

It would seem fruitful to discuss continuing education in neurology as two separate problems: (1) education for those physicians who have had specialty training in neurology and are either Board qualified or Board certified in that specialty; and (2) continuing education for other physicians, both for specialists whose fields are in some ways tangential to neurology, for example, internal medicine, pediatrics or orthopedics and for primary care physicians. This latter group would include physicians who are now general practitioners or whose education now and in the future may be in family practice programs. Education for this group of physicians may in future years include a significant number of individuals who have had paramedical training and are now functioning or will function as physicians's assistants.

Continuing Education for Neurologists

Needs of trained neurologists in the field of continuing education in their specialty are perhaps the easiest to meet. There are a large number of specialty publications in neurology in the English language and most neurologists now have access to libraries which can either supply them with the journals or quickly obtain for them xeroxed pages of articles they wish to review. The American Academy of Neurology offers annually intensive review courses which, in a matter of a few years, cover the new material in most fields of neurology. Medical schools have been surveyed to determine the offering of courses in neurological subjects and at least three-quarters of the schools reported that they participate locally or statewide in continuation courses involving some aspect of the neurosciences. In the past year, for example, ten medical schools have offered courses in some aspect of the neurosciences; most of the courses have been in a neurological "sub-specialty"—e.g., neuropathology, EEG, neurochemistry, neuromuscular disorders. It would seem, therefore, that there are sufficient opportunities for neurologists to receive continuing education in all areas of their field. It would also seem reasonable to have some kind of central coordinating mechanism, possibly through one of the national neurological organizations, for the scheduling of such courses to prevent undue competition and duplication.

Despite the large number of existing journals, a sizable number of neurologists feel that another journal devoted to review articles and interesting case reports would be valuable. With the proliferation of sources of information in the neurological sciences, it is becoming difficult for the neurologist to keep up with the literature "services" that are available. A second type of publication to include an abbreviated listing of such services, including book titles with their table of contents, new journals appearing, abstracting services and brief neurological science reports could be a valuable time-saving resource for the neurologist.

For the neurologist, then, there are ample facilities for continuing education, both in written and course form, especially now that a self assessment examination has become available. Approximately 1,200 neurologists (including those in training) registered for the first such inservice and continuing self assessment examination. This development combined with existing and proposed sources of information for neurologists would seem to ensure that provisions for the continuing neurological education of neurologists are adequate.

Of course, opportunities available are not the same as opportunities taken. It is quite possible that most if not all neurologists make use of the continuing education resources available. Still, given the importance of continuing education for ensuring the provision of adequate health care, reliance solely upon individual effort, judgment and conscience to maintain professional skills appears out of step with current and justified attempts to introduce formal accountability procedures into professional practice. Thus, it is recommended that the national neurological organizations take steps to assess the evidence of the neurologist's competence in his specialty on a continuing basis.

Continuing Education for Other Physicians

A more difficult problem is the determination of how much specialized knowledge in neurology is or should be required of, for example, internists or family practitioners. Related to this problem are those of defining the population of professionals and paraprofessionals to be educated in neurology, where this education is to take place, who is to fund it, how it is to be monitored and the reaction of the "students" to programs for their education.

In recent years, several medical schools and even community hospitals have provided education by various mechanisms on newer aspects of medicine, including neurology, to a professional audience. A fairly typical example of such programs is one state medical school which sends small teams of faculty members from the university medical school on a circuit of four small communities in the state twice a year, each faculty member giving a brief talk in each town on some new development in his specialty. In another state, physicians come into the university medical center for one or two days or a week and are given a curriculum in "what's new in medicine." Whether these mechanisms of continuing education, which are beamed at primary care physicians, are effective, and in what ways, is almost totally unknown. In one state it has been noted that the groups of physicians attending the talks are not large and seem to be gradually diminishing in number, although this fact may be a reflection of the diminishing number of physicians in rural areas. The problem of defining which physicians need education in neurological areas, and the related problem of ensuring that they obtain it, is only part of the more general professional problem of maintaining standards of medical care and cannot be dealt with in this report. Two generic problems of postgraduate programs in neurology that are shared by other postgraduate programs should be noted. First, there appears to be a fairly wide discrepancy between material offered and what practicing physicians wish to hear, a fact occasionally engendering a certain degree of hostility on the part of the audience; and second, the rewards for postgraduate teaching are meager. Rarely are academic rewards, in terms of either salary or promotion, clearly attached to continuing education efforts.

Some possible maneuvers for improving continuing education in neurology for primary care physicians are the following:

1.) Establishment of some type of system by which physicians are surveyed to determine the nature of their practice and the caseload they are seeing, whether it includes neurological problems and whether the physicians feel they need continuing education in this area and, if so, how they feel it might best be delivered.
2.) Recognizing and dealing with the problem of how to make continuing education prestigious and rewarding in the medical school setting.
3.) Developing new approaches to the establishment of minimal standards of care. The generic problem here is that shared with all medicine, namely, whether anything can be done to ascertain that the physician who does not have the motivation to keep abreast of recent knowledge in fields in which he deals is providing adequate care for his patient population. As recertification is considered in future years, the solution to this problem will undoubtedly emerge.
4.) It would seem apparent that hospitals with teaching potentials in geographical regions, including the large community hospitals and the medical schools, should have cooperative groups to determine what courses are best given by which organizations. To take a partic-

ularly glaring example, it would seem wasteful for a community hospital and a university hospital in the same city to give an elaborate program on "what's new in neurology" within the same year. As yet, there is almost no mechanism for avoiding this event.

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Appendix XXIII

The Training of the Academic Neurologist

INTRODUCTION

The academic neurologist must carry responsibilities in patient care, teaching, research and administration. Therefore, a satisfactory training program for the academic neurologist should provide the basic structure for a learning experience in each of these areas. The trainee's level of competence will continue to grow for a considerable period of time during his post-doctoral years but the duration of organized, supervised training should be long enough for him to gain the capacity to function effectively by the time he considers himself ready to accept an academic position. Training for an academic career by no means need always follow the same course, nor need it all be undertaken in a single institution. The following guidelines represent what are considered to be desirable patterns of preparation but their principles can be adapted to many different specific courses.

Training in In-Patient Care

Individuals aspiring to academic leadership in a clinical specialty should be superior clinical physicians in their field. Excellence in laboratory investigation without general clinical excellence corrupts the reason for being in clinical departments. A few individuals within a department may be able to accept the luxury of directing their attentions exclusively, or almost exclusively, to laboratory science but leaders in the specialty must accept the fact that their peers and their students will judge them primarily by how they perform in the clinical specialty and how well they function as clinicians.

Training in clinical neurology is most effectively acquired by trainees who can concentrate most of their time and attention on the nervous system and its problems. One or two years of postgraduate training in internal medicine is the best background for a neurological trainee but it is reasonable to assume that other preliminary training which gives the potential trainee responsibility for the care of sick patients under the supervision of experienced non-neurological clinicians might be just as satisfactory. The time required for this preliminary training will vary with the individual and the training program.

Education in Teaching

Opinions vary widely about the relative values of various teaching techniques. However, those who plan to become clinical teachers need guidance in matters such as how to make clear and articulate oral presentations, how to express themselves in clear, terse prose, how to prepare and use satisfactory visual aid material and how to prepare effective outlines and other materials for presentations to students. Programs which assume the responsibility for training academicians should guarantee that at least these minimum points are covered. In addition, each trainee should have specific teaching responsibilities which are monitored so that the trainee's strong points can be brought out and his errors corrected.

Research Training

The pattern, content, formality and duration of research training for future academicians are difficult to define exactly. The degree and nature of preparation will vary, depending upon the individual's potential interests. Nevertheless, the period of research training and development for many neurologists in academic life has been too short to allow them to develop the level of quality and excellence that the unsolved problems in the field require. At least two years spent with a heavy commitment in research will probably be necessary to prepare academicians for the future. Support for the individual during this time should be sufficiently high so that domestic distractions do not interfere and clinical and teaching responsibilities should be kept at a minimum. In the natural sciences this seemingly lengthy period of formal training in research is probably insufficient to prepare a fully independent investigator and a further period of sheltered development for 3–5 years is probably desirable in most instances. If the academic neurologist is to gain the respect of his scientific peers, he must himself be accepted as a scientist.

Programs such as the Research Career Development Award program of the NIH are exceptionally important in the planning of academic development. In addition, since science is best learned and practiced while young, candidates who decide on an academic career should be encouraged to initiate research training as early as possible, ideally during the undergraduate years of medical school. Fellowship years interspersed during residency training in medicine and formal residency-fellowship in clinical neurology are of great value. Such experience allows the clinical trainee to think about research problems while he is responsible for patient care. This creates the optimal environment for identifying the unknown in relationship to clinical disease, which is, after all, what clinical specialties are all about.

Preparation in Administration

Some preparation in administration is desirable for all academics. Each clinical trainee should have experience in organization and administration of the clinical service and each research trainee should be given the opportunity to prepare a small application, or parts of a large application for a grant. It is desirable that trainees at an advanced point in their training should be given responsibility over grant disbursements and an understanding of how the grant relates to the University's administrative policies. Trainees should also become familiar with the policies of granting agencies, particularly the larger ones, and should be advised as to the sources from which fellowship funds, research funds and travel support are obtained. It takes time for trainees to learn how distractive medical school administrative chores can be; they should learn to realize that committee chairmanships rarely compensate in long-term intellectual rewards for lack of experience and success at the lab bench. Specific courses in administration are not likely to be useful but program chairmen and others should outline administrative principles, practices and hazards to the younger men in training and at the junior levels of a department.

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